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Executive Summary

Research and innovation policy in Belgium is designed and implemented in a multi-level governance framework involving the Federal Government and autonomous regional and (linguistic) community governments. Although complex, the clear constitutional demarcation of responsibilities means that in practice there is no reason for the various authorities not to be able to design and implement effective policies. Indeed, the possibility for the three regions (Brussels-Capital, Flanders and Wallonia) to design policies that suit the specific needs of their business sectors for innovation and that are tailored to optimise the potential of their higher education research capacities can be considered as positive.

Despite a commitment by all of the competent Belgian authorities to meet the 3% gross expenditure on R&D (GERD) in gross domestic product (GDP) target, GERD has only increased marginally in absolute terms in recent years. In 2010 it was just under 2%. Despite the fact that R&D tax credits make up approximately €500 million additional public support, **public expenditure on R&D remains the weak link** in the Belgian system. Public sector funding for R&D is unlikely to increase in the short term given the need for budgetary rigour. Even business investment in R&D which historically has been very strong has begun to show signs of weakening in recent years. One way forward might be to consider lessening the focus on very resource intensive hi-tech innovation in favour of prioritising 'low-tech', service-oriented and/or entrepreneurial types of innovation. Also, focused support for young innovative companies and multinational firms that choose Belgium for their R&D headquarters could broaden the business base. This would require a review of the legal framework for intellectual property rights, the tax burden and administrative red tape.

Belgium, although not among the innovation leaders in the EU, is well placed in the second tier of 'innovation followers' in the Innovation Union Scoreboard 2010 (IUS, 2010) and over the last five years has achieved moderate growth in innovation performance. The country has a strong, internationally competitive research infrastructure (most importantly its universities and a handful of major research facilities) driven by a globally connected and highly productive workforce. At the same time, the business sector in Belgium is significantly more active than the EU-27 average in terms of both the financing and performance of research and development (R&D). A small number of foreign owned companies play a key role in underpinning this strong performance with the R&D investments of a few large companies in a limited number of sectors and mostly managed overseas making significant impact on the performance figures. As a whole, the country is characterised by the relatively large share of SMEs, which typically make lower R&D investments as well as having lower absorptive capacity for knowledge. One important challenge is to **link research capacities to the economic eco-system**. Several measures are in place in each region aimed at economic exploitation of research, but it seems that research outputs are not aligned with the absorptive capacity of the SME-dominated economy.

While Belgium has strengths in terms of openness and international knowledge exchange and a well educated population, it needs to **improve its human resource base in science and technology**. Apart from policies to improve the comparatively poor working conditions for researchers (salary, career prospects, financing for

projects) increasing the numbers choosing to enter the profession (e.g. awareness and image-improving campaigns), improving the number of graduates in the S&T domains and creating easier access to the labour market for an increased number of foreign graduates are areas for improvement. To this end, a number of programmes have been setup in communities and regions, and partnerships for researchers have been created, such as the Wallonia-Brussels Partnership for Researchers which was set up in 2011, where public authorities undertake, alongside the research stakeholders, to place researchers at the centre of the agenda for the consolidation of research as a driver of the future.

On the institutional level, there is a **need for enhanced co-ordination between the authorities** in terms of the use of financial resources available and the deployment of specialised staff required to pursue common objectives. Similarly, the remaining responsibilities of the Federal Government, in fields such as taxation, corporate law (including intellectual property), mean that the implementation of certain regional initiatives may be conditional on coordination with Federal policy. If anything, fragmentation of the innovation system is more problematic at the regional level where a 'sub-regionalism' leads to a multiplication of stakeholders in the different layers of regional governance. More positively, there has been in recent years a consolidation of smaller universities and third level institutes into larger partnerships with the major universities.

As regards the **policy priorities**, in Wallonia and the Wallonia-Brussels Federation, the Research Strategy 2011-2015 was published end 2011 as a follow-up to the willingness they had demonstrated for closer cooperation between the different policy levels (cf Marshall Plan2.Green). This document sets out eight strategic objectives (including reiterating the 3% objective), identifies five priority thematic areas and includes a detailed plan of action for meeting the objectives. The five thematic fields identified are: sustainable development, energy, research in technological fields, health and ageing and quality of life. Although technically a policy statement of the afore mentioned governments, an additional aim of the Strategy is to develop a joint action plan with the Brussels-Capital region. The current Regional Innovation Plan of the Brussels Capital Region (2006) covering the period 2007-2013 focuses on regional R&D strategic platforms, clusters and plans to increase regional R&D spending up to the 3% target focussing on three sectors: ICT, life sciences and environment. In 2011 the region started the preparation of a new regional RDI strategy in line with the EU 2020 strategy, in particular adopting smart specialisation priorities. In Flanders, the regional R&D strategy is based on the plan Flanders in Action (FiA), which aims at making Flanders one of the top five EU regions by 2020. Detailed goals related to research and innovation policies are set out in the Policy Letter 2010-2011. Main priorities are: (i) a focused innovation strategy, (ii) improved innovation peformance in the economy, (iii) making Flanders a top region by proving it to be receptive for innovation, (iv) reinforcing science as fundamental driver of innovation and increase the intensity, efficiency and impact of R&D. In 2011, the concept note on "Flanders Innovation Centre" indicated the importance of societal challenges and identified so-called 'innovation crossroads (or hubs)' where the strengths of the Flemish innovation system meets the needs of Flemish society.

Over the last years, the **trends in the priorities of the policy-mix** in each of the three Belgian regions have tended to display some distinctive features, reflecting their specific institutional and economic environments. At the same time, a number of measures are similar in their objectives yet differ in the approach to implementation. A common feature of both the Flemish and Walloon systems is the emphasis on

measures aimed at encouraging increased co-operation between the research base and enterprises. In addition, the overall efforts to structure and develop major specialised 'clusters' of R&D and innovation need to be pursued and further consolidated. The evidence from the Flemish strategic research centres suggests that it may take years before such initiatives become fully operational and realise their objectives, achieve 'critical mass' and attain international recognition. The Walloon competitiveness clusters and the research and technology centres created over the last decade will need sustained funding, regular evaluation and expert management if they are to begin to contribute effectively to structural adjustment of the economy. The realignment of research and innovation policies to contribute to tackling the structural adjustment of the economy or for taking on 'grand challenges' will require better orientation and focus of the limited amounts of public funding available. There is currently limited recent evaluation evidence on the effectiveness of the measures in place and a wide-ranging review would be beneficial in each region in order to focus regional support on initiatives best able to contribute to raising the intensity of industrial R&D and innovation (including service sector and other non-technological forms of innovation).

The Belgian authorities are strongly committed to and participate in European initiatives, especially the EU Framework programme for R&D, or in related initiatives such as the ESFRI programme on research infrastructure. In a number of cases this commitment matches national challenges or priorities, for instance, the implementation of the European Partnership for Researchers in both Communities, which should make it easier to attract and retain qualified human resources. With regard to cross-border cooperation, Belgium is actively engaged in a range of European initiatives, as well as a number of federal and regional initiatives, which include bilateral agreements, joint-R&D projects and shared research infrastructures. Most instruments in innovation policy are, however, still nationally/regionally oriented and not open to cross-border or cross-regional cooperation. An interesting recent evolution is the stronger focus since 2011 on the coordination/opening of programmes between the Walloon and the Brussels-Capital regions, in parallel to the stronger coordination between Wallonia and the Wallonia-Brussels Federation.

Given the economic crisis over the last 5 years, the Belgium economy and research and innovation system appears to have 'weathered' the storm better than some other neighbouring countries. The introduction and extension of R&D tax reductions on researchers' salaries may well have acted as an 'automatic stabiliser' without which R&D intensity would have declined rather than remaining relatively stable. Similarly, tax incentives for business may have contributed to maintaining the relative attractiveness of Belgium as a place to do research. The structuring of the higher education system should foster, if the correct policy incentives are in place, a corresponding realignment the way research is carried out. This is one element that would help to reduce the overall fragmentation of the Belgian research system and further improve its performance. At the same time, the balance between institutional and competitive funding of the system would merit further review in order to further focus and concentrate efforts. Finally, while the remit of the Federal Government to fund 'nation' wide research programmes has been further limited[1], there is a clear rationale for organising joint programming, sharing certain research infrastructures or 'pooling' research efforts in certain fields. This has already been possible for

[1] With the decided transfer of the inter-Community programmes Inter-University Attraction Poles and Technology Attraction Poles to the Communities and the Regions

coordinating Belgium's participation in the research infrastructures fields of the ESFRI roadmap. It is to be hoped that the proposed Inter-Federal Plan for Research and Innovation will lead to concrete initiatives.

TABLE OF CONTENTS

Introduction

Belgium is a densely populated federal state (10.8m inhabitants in 2009, 2.2% of EU-27) formed of three regions: Flanders (6.2m), Wallonia (3.5m) and Brussels-Capital (1.1m); and three language communities: Flemish (6.2m Dutch speakers), French (4.3m) and German (75k). Belgium is relatively wealthy with a gross domestic product (GDP) per capita of 118% of the EU-27 average and annual GDP growth of 1.9% in 2011. However regional differences in wealth range from Wallonia 86%, Flanders 117% to Brussels-Capital 223% of the EU-27 average in 2009[2]. The economic downturn in 2009 hit productivity, but there were quick signs of recovery. GDP per capita was €32.3k in 2008, decreased to €31.5k in 2009 and recovered to €33.5k in 2011.[3]

Belgium, although not amongst the innovation leaders in the EU is well placed in the second tier 'innovation followers' (Innovation Union Scoreboard, IUS 2010) and over the last five years has achieved overall moderate growth in innovation performance (European Commission, 2010). Belgian gross domestic expenditure on research and development (GERD) increased from €600/capita in 2007 to €650/capita in 2010. Relative to GDP, GERD was 1.99% in 2010, slightly below the EU-27 average (2%). Public R&D expenditure is the weak link, despite increasing since 2007, at only 0.66% of GDP in 2009. Tax credits have been increasingly important since their introduction in 2004. In 2009 tax credits are slightly above €500m, adding around 0.15% of GDP to the public budgets (GBAORD).

Government intramural expenditure on R&D (GOVERD) increased from €513m in 2007 to 662m in 2010; it became more important in the governmental appropriations to R&D as it rose from 8.1% to 9.4% of total Government Budget Appropriations on R&D (GBOARD) in the same period.[4] Business expenditure on R&D (BERD), on the other hand, is above the EU-27 average (1.32%) although growing less rapidly than the EU-27 as a whole in the last five years. In relative terms, BERD accounted for 70% of GERD in 2007, and 66% in 2010. Overall, the IUS 2010 results suggest that Belgium business innovation performance and the economic effects of this activity have become weaker over the last five years (Ibid.).

In terms of human resources for research and innovation, Belgium has a relatively high and growing share of human resources in science and technology (HRST) (49.3% in 2010 – compared to 40.5% in EU-27) and researchers (1.22% in 2010) of the total active labour force. However, the share of new science and technology (S&T) graduates in tertiary education graduates is lower (16.3% in 2009) than the EU average (22%) and decreasing. In 2007, the geographical spread of the 58,000 full time equivalents (FTE) researchers was as follows: 60% in Flanders, 23% in Wallonia and 16% in the region of Brussels-Capital. Almost 60% of the R&D personnel are active in the business sector (EU-27, 52%) and 35% in the higher education sector.

[2] Latest available year (Eurostat)

[3] Eurostat, 2011

[4] BELSPO, 2011

Belgian academic researchers are relatively productive with a share of 1.6% of the total world publication output in 2008. On average, Belgium produces 13 publications per 10,000 inhabitants, well above the EU-27 (7.4), Japanese (6.1) or even US (9.9) average. They are also internationally orientated with 54% of publications internationally co-published and with relatively high impact scores (150% of the global average). The Belgian direct citation impact is high (field normalised impact is 1.27 for 2005–08), particularly in health and agriculture (Tijssen et al., 2010).

A comparative study of sectoral strengths in science, technology and economy, the so-called "specialisation profiles", was performed within the smart specialisation study of the OECD Working Group on Innovation and Technology Policy (ECOOM & EWI department, 2011). This study analysed the relative performance of Belgium, focusing on scientific development (based on the analysis of publications [5]), technology development (based on patent analysis) and economic development (based on labour market data). Belgium has a relative high activity compared to the reference countries[6] in the major science fields of: biology, clinical and experimental medicine and neuroscience and behaviour. The top three technology specialisation profiles, with the highest share of patents, are: macromolecular chemistry & polymers, textile & paper machinery and other special machinery. The top three economic specialisations are manufacture of chemicals & chemical products, post & telecoms and manufacture of basic materials. The analysis highlights a mismatch between knowledge production and the technological and economic fabric of the country, as the strengths in science do not correspond with the technological and economical strengths.

Patenting has increased since 2000 with, in 2009, 142 patent applications per million inhabitants to the European Patent Office (EPO) and 166 to the United States Patent and Trademark Office (USPTO) (117% and 122% of the EU-27 average respectively). Chemistry, which accounts for more than 30% of applications, is the leading technological field. There are strong regional disparities in patenting from low levels in the service-oriented Brussels-Capital economy, close to the EU-27 average in Wallonia and well above Flanders. Given this strong patenting activity there are still indications that Belgium does not fully exploit its technological strengths. The total entrepreneurial activity (TEA)[7] is particularly low compared to innovation–driven economies in the EU (Lepoutre et al. 2010), whereas the absorptive capacity in industry is rather low due to the large share of SMEs (97.2% of Belgian companies have less than 50 employees in 2008, 0.4% have more than 200 (Union Wallonne des Enterprises, 2010). The diffusion power of the Belgian innovation system is in general considered as low, the R&D and innovation efforts have yet to bring sufficient new activities capable of ensuring economic development of the country. Even if manufacturing industries and services with high technological content have a strong importance in Belgium, such as pharmaceuticals or ICT activities, the added value is indeed rather low. Gross value-added of the industry in 2009 was 16.3%, which is below the EU-27 average (18%) and below the level of 2000 (22.3%). Furthermore if one considers the lower level in Belgium as compared to the EU-27 of the community

[5] Analysis of the so-called Activity Index

[6] Australia, Austria, Czech Republic, Finland, Germany, Netherlands, Poland, South Korea, Spain, Sweden, Turkey and the UK

[7] The total entrepreneurial activity (TEA) index indicates the percentage of labour force actively involved in setting up a new business, or being the owner/manager of a company less than 42 months old.

trademarks and designs as well as the technology balance of payments flows, the R&D and innovation efforts do not seem to lead to significant economic outputs.

The various Belgian authorities are fully autonomous. Constitutionally there are seven Belgian authorities[8], in practice there are five active entities when it comes to science, technology and innovation (STI) policy as the Flemish Region and the Flemish community merged their institutions and the German community does not have a research policy (see Figure 1 for an overview of the responsible governments and a full overview of the STI governance system).

The Federal Government has competence for the federal scientific institutes, intellectual property (IP) law, standardisation, fundamental metrology, nuclear research, corporate taxation, employment legislation and social security. The communities are competent for matters related to individuals including scientific research and (higher) education, and the Community Scientific Institutes; the regions are competent for territorial matters such as energy, environment, and economic support, thus including innovation, applied and industrial research, science parks, and technology transfer (see Ziarko, Reid & Bruno (2010) for a more detailed overview of the system).

The following ministers are responsible for research and innovation matters: the Minister for SMEs, Agriculture and Science Policy and the Minister for the Enterprise and Simplification at the Federal Level; the Minister in charge of the Economy, External Trade, Employment and Scientific Research in Brussels-Capital; the Minister for Innovation, Public Funding, Media and Poverty Prevention at the Flemish level. Since 2009, Wallonia and the Wallonia-Brussels Federation (previously called the French Community) have had one sole minister responsible for scientific research and infrastructures (at both levels) and the same minister responsible for higher education at the community level, and for business, external trade and new technologies at the regional level. Other ministers from either government are autonomously responsible for funding research in their specific fields of competence (agriculture, environment, energy, health).

The Federal Science Policy Office (BelSPO) coordinates federal science policy as well as specific aspects of international co-operation on behalf of the Belgian authorities (for instance, space and polar research). It is responsible for the design and implementation of research programmes and the supervision of 10 federal scientific establishments. Another actor at the federal level is the FPS Economy, SME's, Self-employed and Energy which deals with intellectual property, standardisation, fundamental metrology, nuclear research and research regarding the continental shelf. Co-operation between the various governments takes place in the Inter-Ministerial Conference for Science Policy (CIMPS/IMCWB) and two permanent sub-committees CIS (International Co-operation) and CFS (Federal co-operation). Coordination tends to focus on practical issues such as carrying out harmonised statistical surveys and submission to the European Commission, Eurostat, OECD, etc. of statistics or policy surveys.

In Flanders, STI policy is designed and governed by the Economy, Science and Innovation (EWI) department, while various agencies implement policies. The main agencies in Flanders are IWT, responsible for innovation-related matters, and FWO for science-related matters. With regard to science, there is a certain overlap with the

[8] The Federal Government and the regional governments of Flanders, Wallonia, Brussels Capital, and the Flemish, French and German Communities

portfolio of the minister responsible for education and the Agency for Education and Training (AgODi). In the innovation area there is a certain linkage with the economy portfolio and the Enterprise Agency Flanders (AO) as well as the PMV agency for guarantees and loans.

In Wallonia, both industrial research funding and funding for research centres is managed by the General Directorate for Economy, Employment and Research (DGO6) of the Public Service of Wallonia. In Brussels-Capital, the INNOVIRIS agency manages subsidies for R&D and innovation for enterprises and research organisations. The main Federal stimulus to business and higher education R&D is provided through a tax credit that reduces the employers' contribution to the wage tax of R&D personnel. BELSPO also provides grant funding through targeted programmes. Funding of basic research and scientific research funding based on excellence to higher education institutions (HEIs) is provided by the two Communities' administrations: EWI in Flanders and the Directorate General for Non-Compulsory Education and Scientific Research at the Ministry of the Wallonia-Brussels Federation (DGENORS). They deliver most of these funds through two agencies, the FWO (Research Foundation Flanders) and the F.R.S.-FNRS (Scientific Research Fund of the Wallonia-Brussels Federation).

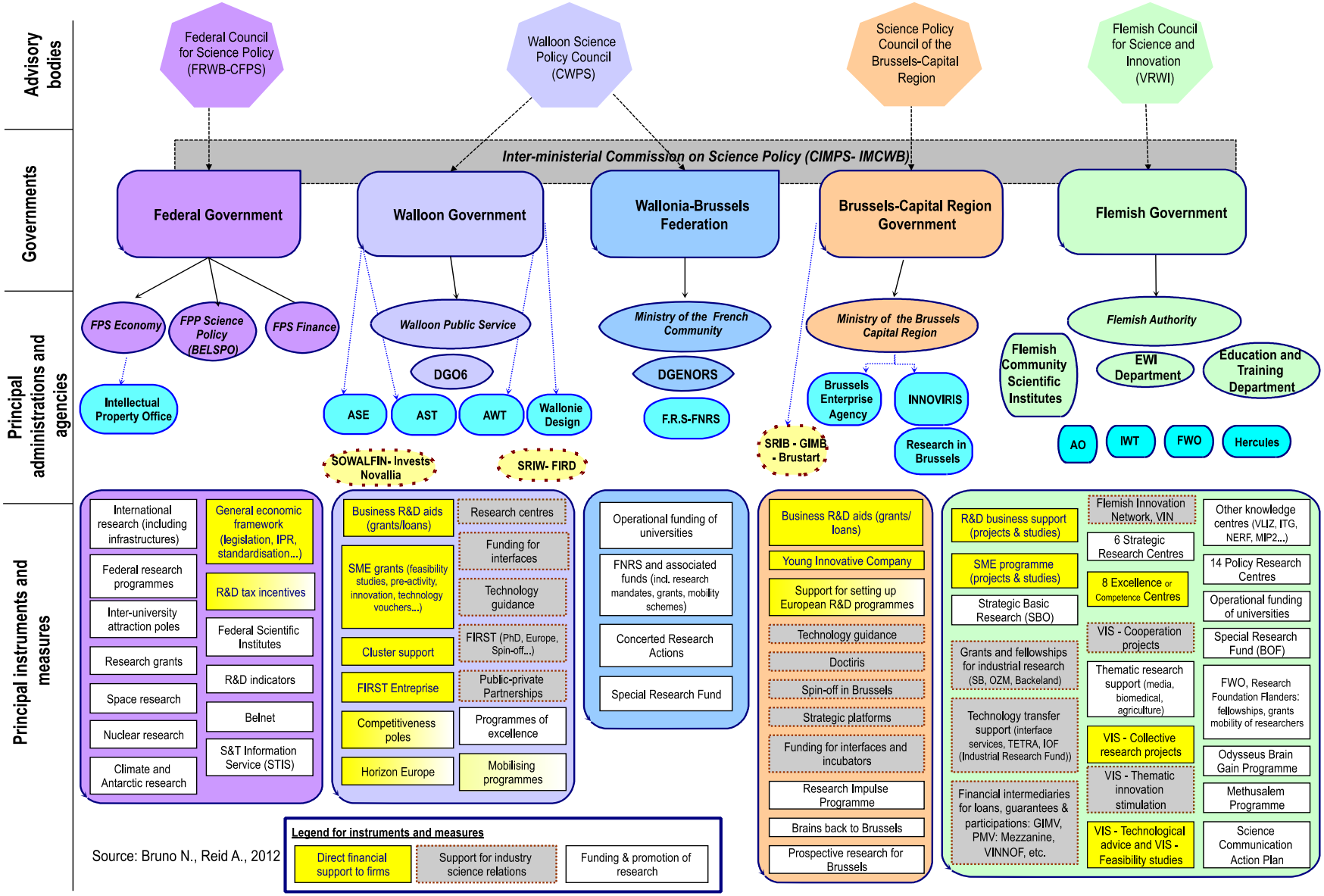
In the region of Brussels-Capital, INNOVIRIS[9] (Institute for the support of Scientific Research and Innovation of Brussels) manages the implementation of research and innovation funding.

As well as providing the most funding, the business sector also performs a majority of R&D in Belgium. The other main research performers in Belgium are the HEIs (universities and university 'colleges'). There are two separate university systems, six French-speaking universities (including two in Brussels) and 21 university colleges ('*hautes écoles*'), and six universities and 22 university colleges ("hogescholen") in Flanders (also including Brussels). Due to the Bologna reform process, the universities have been structured into three academies (Wallonia) and five associations (Flanders)[10]. In addition to the HEIs, a core feature of the Belgian system is the existence of collective research centres, which are private initiatives in which member firms initiate, often through technical committees, topics for R&D. The 'De Groote' centres and the assimilated De Groote centres operate in all Belgian regions; the autonomous collective research centres reflect the regional mandate for S&T policy developed since the 1990s. In addition large inter-university research centres are located in Flanders, including four large strategic centres: IMEC, VITO, VIB and IBBT and two research centres are currently under development in the fields of health (CMI)[11] and materials (SIM). In Wallonia, multi-stakeholder research platforms have been established between universities, research centres and business sectors funded by a mix of Walloon and European funds as well as by the six competitiveness clusters of Wallonia.

[9] INNOVIRIS was called IRSIB/IWOIB till 2010

[10] Wallonia: Louvain, Wallonie-Bruxelles and Wallonie-Europe; Flanders: Leuven, Antwerpen, Gent, Hasselt, Brussels

[11] A virtual research centre that aims to stimulate joint translational research based on biobanks (*i.e.* biomedical databases, including biological samples



Source: Bruno N., Reid A., 2012

Structural challenges faced by the national system

Belgium is ranked sixth in the EU-27 by the 2010 Innovation Union Scoreboard and is amongst the group of "innovation followers" (second after the UK). There remain a number of challenges including an overall governance challenge and three main structural challenges. The latter differ in intensity between the regions.

Challenge 1: Increasing co-ordination and synergies within the governance system

The multi-level governance of the Belgian system creates specific challenges (Boekholt & Georghiou, 2011) such as a risk of sub-optimal scale of public-private investments that may create disincentives for co-operation between the main research performers and businesses at an inter-regional level. Given the trend to further empowerment of the communities and the regions, policy making in scientific research and innovation happens essentially at community and regional level, but several important policy areas that influence the effectiveness of research and innovation policies, such as the tax system, remain at the Federal level. While co-operation and coordination mechanisms exist essentially at operational level regarding international issues, co-operation and coordination regarding national issues is much more sporadic. Co-ordination happens through bodies like the CIS (dealing with research and innovation) and the CEI (dealing mainly with the economy and non-research related innovation). Intra-regional co-operation is increasing with neighbouring countries (for example, the Leuven-Aachen-Eindhoven triangle). At the same time, the communitarisation and regionalisation of research and innovation policy enables each community and region to pursue diversified strategies that respond to specific socio-economic challenges or to further boost specialisations. The newly installed Federal government acknowledges such advantages of regionalisation while seeking to limit any 'negative externalities' by proposing, in the Government Agreement that *"there should be an inter-federal plan for research and innovation*" that "*will make technological innovation more efficient*", "*while respecting each entities' competences*" (Belgian Federal Government, 2011).

The issue of fragmentation also exists at regional level with several studies in both Flanders and Wallonia pointing to the drawbacks of sub-regionalism and an institutionally heavy system of intermediaries and sub-critical research centres. Initiatives such as the strategic research centres and excellence centres in Flanders and the Competitiveness Poles in Wallonia are an attempt to structure the R&D capacity in specific fields and sectors. However, a rationalisation of intermediary structures and a centralisation and professionalisation of business advisory networks and financing structures would provide more cost-effective support to business innovation.

Challenge 2: Under-financing of research

Relatively speaking, the Belgian innovation system is under-financing research (Boekholt & Georghiou, 2011) with R&D intensity below the EU average. The challenge is twofold: to increase public funding for R&D faster than the increase of GDP, and to leverage renewed growth of business expenditures on R&D.

Despite an absolute growth, Belgian public expenditure on R&D as share of GDP remains lower than the EU-27 average (0.66% in 2009 in Belgium, against 0.75% in

the EU-27. Public sector investment is particularly low in Wallonia (0.54%), whereas levels in the region of Brussels-Capital (0.68%) and Flanders (0.71%) are closer to the EU-27 average. As Belgium has a high level of public debt (98.2% of GDP in 2011), the pressure to reduce public deficits in response to the financial crisis will limit the room for manoeuvre for a sustained increase of public investment in R&D. Both Brussels-Capital and Wallonia will struggle to maintain investment levels in R&D, as co-financing from the Structural Funds will begin to fall post-2013 (Walloon Council for Science Policy, 2010). It is noteworthy though that R&D tax credits play an important role in public efforts for supporting research, representing approximately €500m in 2010 (28% going to HEI and research funds, 12% to scientific organisations and 60% to enterprises, according to BELSPO data). These efforts are nonetheless not included in the 3% target calculations.

At the same time, business investment in R&D has been declining, in both absolute and relative terms and business R&D is concentrated in a few hundred companies (BELSPO 2010). In 2009, 88% of BERD was performed by companies with more than 50 employees (and 42% with more than 1000 employees, up to 56% in Wallonia) and 9.8% of BERD was financed by capital from abroad. The role of foreign owned firms in the Belgian economy is significant (Belgium is fifth in the world in terms of foreign direct investment (FDI) stock) with 40% of industrial turnover controlled by foreign owned firms. The share of BERD by foreign owned firms is even higher, at close to 60% (in 2005, OECD 2009). Thus the country structurally relies on the R&D investments of a few large companies often with decision centres abroad, such as BASF, Bayer, EXXONMOBIL, ON Semiconductor, Philips, Procter and Gamble and Siemens[12]; which makes BERD sensitive to budget cuts abroad (and thus to economic conjuncture). Belgium is characterised by the relatively large share of SMEs, which typically make lower R&D investments as well as absorptive capacity for knowledge. Due to the lower absorptive capacity, lower focus on technological innovation but more low-tech, service-oriented and/or entrepreneurial types of innovation could be fostered. Also, focussed support for young innovative companies and multinational companies that choose Belgium for their R&D headquarters could broaden the business base and reduce the dependence on strategic decisions taken by multinational companies abroad (Bruno & Van Til, 2011; 2010), e.g. acting on the legal framework for intellectual property rights, tax burden, administrative red tape.

Challenge 3: Mobilising Human Resources for science and technology

While Belgium has strengths in terms of openness and international knowledge exchange (Innovation Union Competitiveness Report 2011) and a good level of education of the population, it needs to improve its human resource base in science and technology. An indication of this relative weakness is the low number of new doctoral graduates (ISCED 6) per 1000 population aged 25-34. Belgium has a ratio of 1.4 compared to the EU average of 1.7 (2009). The share of new science and engineering graduates among new tertiary education graduates is also well below EU-27 average (16.3% against 22% in 2009). Another indicator that is not improving in recent years is the share of the population aged 25-64 participating in life-long learning, which is also well below EU-27 average (6.8% against 9.3% in 2009). In addition, the focus on the use of the Belgian languages in the research grant systems for PhDs can be regarded as a barrier to European mobility as means of sourcing qualified human resources.

[12] Examples taken from the Top-50 of R&D intensive companies, appearing in the R&D-survey of 2008 and 2010 (ECOOM, 2011)

In case additional funding is realised, the shortage of researchers will remain an important issue. Apart from policies to improve the comparatively poor working conditions for researchers (salary, career prospects, financing for projects) increasing the numbers choosing to enter the profession (e.g. awareness and image-improving campaigns), improving the number of graduates in the S&T domains and creating easier access to the labour market for an increased number of foreign graduates are areas for improvement. In particular, the below-average remuneration of researchers in the higher education institutions (68% of the remuneration in the business enterprise sector in Belgium, CARSA 2007) as well as language restrictions[13] hampers the internationalisation and the attractiveness of the Belgian system (Verbeek, 2007). This requires more effective measures to become an attractive country for researchers.

Another aspect of this challenge is related to the available budget for researchers (Challenge 1) and research projects, which potentially reduces motivation particularly for young researchers trying to build their research careers[14]. Therefore, there is a challenge to increase the availability of opportunities for particularly young researchers, in order to prevent brain drain, which is regarded as a threat (De Standaard, 2010). To this aim, a number of programmes have been set up, such as Odysseus, Methusalem or the new Pegasus programme since 2011 in Flanders that are linked to the Marie Curie programme of the EU, or Brains Back to Brussels in the region of Brussels-Capital. In the Wallonia-Brussels Federation, thanks to the refinancing of the F.R.S-FNRS, new research mandates can be supported since 2010 (but the number of permanent researchers is still set at 400) and initiatives also exist to support researchers coming back to Belgium.

Challenge 4: Matching knowledge production with the economic fabric

Despite the high research outputs in quantitative and qualitative sense and relatively high investments in research centres and R&D measures, the take up by Belgian companies appears to be sub-optimal (Bruno & Van Til, 2010, 2011; ECOOM, 2011). The number of patent applications is 94% of the EU-27 average (IUS, 2011) and the Belgium triadic patent families seem low with a share of 0.8% (OECD, 2010). The main challenge is to link the accumulated research capacities to the economic eco-system. Several measures are in place in each region aimed at economic exploitation of research, but it seems that research outputs are not aligned with the absorptive capacity of the SME-dominated economy. In Flanders, strategic research centres offer high-class and knowledge intensive services, but these are often only used to a limited extent by players from Belgium. Imec, for instance, is considered to be a world-class research institute, but although it attracts a lot of industrial players from all over the globe, it struggles to link to Flemish companies, as this sector is marginally represented in Flanders. From a business perspective, the limited public support to an economically important sector like the chemical industry (in Flanders: 40% of BERD and 27% R&D personnel) is striking (Van Til, 2011)[15]. A recent review of the science production (publications), the technology production (patents) and the economic specialisation (employment) by ECOOM & EWI Department (2011) further

[13] It is indeed regulated by law that PhD courses are offered in the community language only.

[14] Remuneration of young researchers is particularly low when compared to similar countries (CARSA, 2007).

[15] An initiative on sustainable chemistry has been in preparation, which resulted end 2011 in the establishment of a new Excellence Centre, the FISCH initiative.

substantiates a certain mismatch between knowledge production and the economy in Flanders (see Chapter 1).

Assessment of the national innovation strategy

National research and innovation priorities

In December 2011, a new Federal Government was finally sworn in after 541 days of negotiations. The government agreement sets out a range of measures to tackle the financial crisis and contains a number of austerity measures. In the field of R&D, major cutbacks are not planned; however, the indirect R&D tax subsidies will be under review. The Federal Government's Coalition agreement points to a need for more coordination between the communities, the regions and the Federal Government in order to achieve the 3% target. The aim is to develop an inter-federal plan for research and innovation. Noteworthy though is the plan to terminate the federally-organised and supported inter-university 'attraction poles' as of 2017[16]. These poles are one of the very few initiatives fostering collaboration in basic research between the North and the South of the country.

Although there is no national strategy, each region/community has its own multi-annual plan that covers research and innovation (either as a sub-element of an overall plan or as a specific strategy), namely: the Flanders in Action initiative (Pact 2020); the Brussels-Capital Regional Innovation Plan (PRI 2006); the Walloon "Marshall Plan 2.Green" completed recently by the Research Strategy 2011-2015 and the Wallonia-Brussels partnership for researchers, both adopted by the Wallonia-Brussels Federation and the Walloon Region in 2011. Moreover, the 2011 Federal Government Agreement foresaw the drafting of an overarching inter-regional STI-strategy in order to reach the 3% GERD/GDP target and meet the goals of the National Reform Plan and the EU 2020 Strategy. The inter-regional/community plan would aim to improve the coordination and efficiency of STI policy.

Following the regional elections, the formation of the Walloon and the Wallonia-Brussels Federation governments was based on a common political strategy. This strategy has been translated into an operational plan called the Marshall Plan 2.Green (Plan Marshall 2.Vert, budget of €1.6b over five years (2009-14)), which endorses the 3% Objective and aims to improve competitiveness of firms by improving the performance and integration of research with industry. This plan is a continuation and a reinforcement of the previous plan implemented during the period 2006-09. The addition of 'Green' underlines the new orientations to better integrate 'sustainable development' as a crosscutting priority. The third priority area of the new plan 'Strengthen scientific research as an engine of the future' incorporates the main actions to be pursued during the 2009-14 period as regards STI policy. Funds from both authorities were sought to be invested in the implementation of a joint research strategy, which also involves the Brussels-Capital Region, and focuses on strategic crosscutting themes e.g. sustainable development, renewable energy, new technologies, longer life, etc.

As a follow-up, a Framework Policy was published in November 2011 entitled Research Strategy 2011-2015 "Towards an Integrated Research Policy". This document sets out eight strategic objectives (including reiterating the 3% objective),

[16] Butterfly agreement on the 6th state reform from October 2011

identifies five priority thematic areas and includes a detailed plan of action for meeting the objectives. The five thematic fields identified are: sustainable development, energy, research in technological fields, health and ageing and quality of life. A first new measure was launched to support public-private partnership working on these thematic fields (PPP-2012). Although technically a policy statement of the Walloon - Wallonia-Brussels Federation governments, an additional aim of the Strategy is to develop a joint action plan with the Brussels-Capital region.

In addition, the Wallonia-Brussels Partnership for Researchers was also adopted in 2011. It is the contribution of the Wallonia-Brussels Federation to the implementation of the European Charter for Researchers, the European Code of Conduct, the European Commission Partnership for Researchers, the recommendations of the Helsinki Group on Women and Science and the human resources strategy of the "Innovation Union" of the European Union. It is worked out in twenty-five actions divided into six chapters, where public authorities undertake, alongside the actors in research, to place researchers at the centre of the priorities given to the consolidation of research as a driver of the future.

The Regional Innovation Plan of the Brussels Capital Region (2006) covering the period 2007-2013 focuses on regional R&D strategic platforms, clusters and plans to increase regional R&D capacities up to the 3% target. This plan is the result of the agreement between regional government, universities, entrepreneurs and other regional stakeholders. It aims to implement a set of measures to improve the regional innovation capacity. It pursues six strategic objectives:

1. Promote the three most innovative sectors: ICT, Life Sciences and environment
2. Increase the rate of innovation through the implementation of specific programmes;
3. Stimulate the use of innovation through marketing research results and assistance to SMEs so that they assimilate and use innovations;
4. Foster the internationalisation of innovation;
5. Attract and anchor innovative activities;
6. Create an environment that favours innovation.

These objectives were made operational through the introduction of new support instruments and the consolidation of existing ones. The sectors were selected because of the identified potential as regards research, innovative content, growth and job creation in Brussels. In 2011 the region has started the preparation of a new RDI strategy for the region in line with the EU 2020 strategy. The objective is to elaborate a "smart specialisation strategy" for the region by identifying the sectors in which the region will invest, in order to reshape and adapt the financial measures and instruments, rethink a governance model and align the priorities with future EU funding (ERDF, HORIZON 2020).

Flanders in Action (FiA) is the central policy statement of the Flemish Government and is based on an agreement between the social partners aimed at making Flanders one of the top five EU regions by 2020. The FiA plan includes a number of goals related to research and innovation policies which the Minister for Science and

Innovation Policy has set out in more detail in the Policy Letter 2010-2011[17]. In 2011, the concept note on "Flanders Innovation Centre" indicated the importance of societal challenges and identified so-called 'innovation crossroads (or hubs)' where the strengths of the Flemish innovation system meet the needs of the Flemish society. The selected innovation crossroads were: Innovation in care; Eco-innovation; Green energy: Sustainable mobility and logistics; 'social innovation' and 'innovation for transformation of industry'. The innovation crossroads should take into account the six strategic clusters identified in 2006 by the VRWI, after a foresight exercise and SWOT study and an assessment of societal needs through broad-ranging stakeholder round tables. The exercise is supposed to be repeated in 2012 whereby the VRWI should update the study and spearhead domains.

All three regional innovation policies put an emphasis on life sciences as a sector of growing economic importance (employment, or commercialisation of research for instance): the sector is one of the three priority areas of the Brussels-Capital innovation policy; in Wallonia, a competitiveness pole is dedicated to the life sciences and e-health policies are gaining in importance. It is a joint initiative by the three Ministers responsible for Health, Economy and Science & Innovation. In Flanders, the VIB has gained a strong position over many years in the biotechnology and life sciences, and there are new and reinforced initiatives such as the Flanders Care initiative (innovative health), the research centre CMI (medical innovation) and ageing and innovative health care.

Societal challenges are increasingly targeted by research policy since the community and regional elections in 2009. The main evolution is the focus put on broad societal needs and challenges in Flanders[18] and on environmental and health concerns in all regions and in all communities and the willingness to increase collaborations between research actors in the academic and industrial sectors through the continuation of now well-established policies (competitiveness poles, mobilising programmes) and the launch of new ones (technological innovation partnerships in Wallonia, strategic platforms in Brussels-Capital) and the opening of new research centres focused on environmental or health issues. In Wallonia, in addition to sustainable development and energy, health and ageing/quality of life are also priority themes. The innovation crossroads defined in the new Concept Note Innovation Centre Flanders are all oriented towards societal challenges as well.

Belgium focuses on key enabling technologies as well as on specific sectors. Flanders increased its focus on the set-up of cluster initiatives and Strategic Research Centres. In December 2011 after an evaluation, the Management Agreements of three Strategic Research Centres were revised and new ones signed for five years, and in 2010 the Strategic Initiative Materials (SIM) and CMI were launched. The basic ambition is to strengthen the economic position of Flemish industry in Flanders in the medium-to-long-term, by executing and transferring accumulated knowledge through strategic research. End 2011 the FISCH excellence centre was established on sustainable chemistry. Wallonia puts a stronger focus on environmental issues. Following the adoption of the Marshall Plan 2; Green in 2009, specific initiatives were launched in the field of the environment with the creation of a 6th competitiveness pole dedicated to green technologies in 2011 (GreenWin).

[17] Main priorities are: (i) A focused innovation strategy, (ii) Improved innovation power for the economy, (iii) Making Flanders a topregion by proving to be receptive for innovation, (iv) Reinforcing science as fundament of innovation; and Increase the intensity, efficiency and impact of R&D.

[18] Identified in the aforementioned FiA process

Brussels Capital region has launched in 2010 its first ICT strategic platform followed by the strategic platforms in Health (NANO- IRIS and CLINiCOBRU). In 2012 this programme will be extended to the environment sector (renovation of buildings) and a new strategic platform will be set up in this sector.

Evaluation of research and innovation policy is not a systematic practice but all the authorities seek to evaluate specific measures or initiatives or organisations on a periodic basis. For example, in 2011, according to its management contract, the Walloon Technology Promotion Agency (AST) was evaluated[19] and Wallonia invited the OECD to review its regional innovation system (results not yet available). In Flanders, the EWI department set up a dedicated unit for policy monitoring and evaluation in 2009. The influential 2007 Soete review, which recommended simplification and a more "customer friendly set of instruments in Flanders", is currently being updated. Evaluation needs are defined in the programming documents of specific measures and performance indicators are set out in the management agreement for implementing organisations with the Government, which enables a clear and transparent evaluation process. Evaluations at programme level are often assigned to external experts. These are usually published in a complete or summarised version or are available on demand.

In the Brussels Capital Region, even if evaluation practices have been up to very recently very limited, during the preparation of the updated R&D strategy in 2011, the regional R&D system has been assessed (financing, governance, policy mix). At the same time, the region has elaborated a "R&D scoreboard" a tool which should allow monitoring the regional R&D policy at programme and projects level. Furthermore it is planned that Innoviris will set up a specific unit dedicated to the task of monitoring R&D evolution in the region and ensuring a "strategic R&D intelligence".

Over the last years, at Federal level, there has been a move to improve and optimise the fiscal incentives it can allocate to both scientific and industrial research. This effort has made some in-roads into reducing the competitiveness gap for undertaking research in Belgium due to high wages and social charges. The most important measures at the Federal level are the various tax reduction schemes for R&D activities, introduced in the last five years. Given the limited scope for action in favour of enterprise level investments in innovation of the Federal authorities this orientation is coherent and responds to a long running criticism of the ineffectiveness of fiscal measures for R&D and innovation in Belgium.

Over the last years, the trends in the priorities of the policy-mix in each of the three Belgian regions have tended to display some distinctive features, reflecting their specific institutional and economic environments. At the same time, a number of measures are similar in their objectives yet differ in the approach to implementation. A common feature of both the Flemish and Walloon systems is the emphasis on measures aimed at encouraging increased co-operation between the research base and enterprises. A major difference between the two systems has been the strong focus in Wallonia on schemes aimed at encouraging knowledge diffusion through the exchange or temporary assignment of skilled researchers or innovation specialists from the university/research centres to enterprises (and vice versa), the FIRST family of measures. In Flanders, this type of action is subsumed within more general

[19] Evaluation performed by Technopolis Group & ADE, 2011: Associated to a lack of public support, it came out that the lack of proper intervention tools does not allow it to influence its network and that it mainly relies on bottom-up approaches based on the collaboration of the operators (with a diverse success rate). The role, missions and methods of the AST remain unclear after four years of operation.

industrial R&D subsidy schemes. The regions have all made commitments to invest more in R&D and there is concerted effort to focus this funding on either thematic or sectoral approaches such as the Flemish strategic research centres (IMEC, VIB, etc.) and competence poles, or the Walloon competitiveness poles and the Brussels clusters and strategic platforms. An interesting recent evolution is the strong focus on the coordination/opening of programmes (cf. competitiveness poles, S&T awareness raising campaigns) between the Walloon and the Brussels-Capital regions, accelerated since 2011 and the strong coordination of policies between Wallonia and the Wallonia-Brussels Federation.

Trends in R&D funding

As can be seen from the table below, the recent trends in R&D expenditure in Belgium are relatively flat with both GERD and BERD remaining stable in both absolute and relative (to GDP) terms. GERD despite a slight increase remains below the EU average, while BERD is predicted to decline in 2010 (to 1.32% of GDP) while remaining above the EU average (1.24%). Belgian business expenditure on R&D relies heavily on a few large (foreign owned) firms, in chemical, pharmaceutical and biotechnology sectors and the declining trend may reflect an inability to sustain investment during the crisis. Government budgetary appropriations for R&D in Belgium were €2,284m in 2009, a slight decrease from 2008. In percent of GDP, GBAORD decreased slightly from 0.68 to 0.67 and fell below the EU average.

Figure 1: Key R&D and innovation indicators

Indicator	2008	2009	2010	EU average 2010
GDP growth rate	1.0%	-2.8%	2.3%	2.0%
GERD as % of GDP	1.96%	2.03%	1.99% (p)	2.0% [s]
GERD per capita	633.7	618.7	:	490.2 [s]
GBAORD (€ million)	2,344,471	2,289,37	2,375,046	86,428 [s]
GBAORD as % of GDP	0.68%	0.67%	0.67%	0.71% [s]
BERD (€ million)	4,650,011	4,574,767	4,670,503 (p)	151,125,561 [s]
BERD as % of GDP	1.34%	1.34%	1.32%[20]	1.23% [s]
GERD financed by abroad as % of total GERD	12.3%	12.1%	n.a	8.4% [1, s]
R&D performed by HEIs (% of GERD)	22%	24%	23%	24.2% [s]
R&D performed by PROs (% of GERD)	8.9%	8.9%	9.4%	13.3% [s]
R&D performed by Business Enterprise sector (as % of GERD)	68%	66%	66%	61.5% [s]

All Belgian authorities are committed to the 3% target, both at the federal level and the regional levels. However, although all regional authorities have succeeded to

[20] Provisional data Eurostat

increase the absolute GBOARD; this increase is lower than GDP growth rate, so public R&D intensity is stable at around 0.7%. As is recognised by Belgian authorities (see BELSPO 2010b), it will be hard to meet the 3% target, especially if business investment weakens further. In 2011, the Government of Flanders invested €65m of additional resources in R&D, and furthermore an additional €97m of payment resources were allocated for commitments that were entered into in the past for IWT projects (the Agency for Innovation by Science and Technology). Moreover, it also approved a growth path for the R&D investments during the period 2012-2014. The budget will increase cumulatively after 2011: €60m extra in 2012, €70m extra in 2013 and another €70m extra in 2014. As a result, the budget for innovation in 2014 will amount to €200m more than in 2011.

According to the Federal Office for Science Policy, direct support for universities represented 24% (€2,344m) of the total Belgian public funding for R&D in 2008, funding for scientific institutions 14% and project based funding 11%. The latter is allocated to universities via the research funding agencies. Apart from these mechanisms, 18% of funding is through research action programmes, which are open to public research and/or private research agencies and include individual grants for researchers. Some 11% of the total funding is channelled to industrial research. Finally 15% of the government budget is dedicated to the participation in international research programmes (mainly space). Additional competitive funding is channelled through the two main research funds (FWO-Flanders and F.R.S.-FNRS).

Academic funding is allocated primarily on the basis of the number of students and full-time equivalent researchers. In Flanders, a share of the funding for each university is also distributed based on an allocation key (the so-called BOF key[21]). An insufficient share of competitive funding for universities is an impediment to excellence in knowledge production (Verbeek, 2007).

High tax burdens and high labour costs remain a negative element for private parties to conduct research in Belgium. The wage and social security taxes that employers pay for their employees are amongst the highest in Europe; and take-home pay of qualified employees is lower than in competing countries (see section 1 in annex for more details). In order to counteract these disadvantages, Federal tax incentives for R&D were launched in 2003. Belgium provides next to tax credits additional fiscal incentives through reductions in R&D workers' wage taxes and social security contributions.

As of 2007, part of the social security contributions paid by public research institutions (about €31m in 2007) were reimbursed to the two community funds for scientific research (F.R.S-FNRS, FWO) in order to create new research mandates.

The Government Agreement of December 2011 maintains the existing fiscal policies of tax incentives and tax deductions for R&D. This includes the exemption from payment of withholding tax for researchers, investment allowances, exemptions from regional bonuses granted to companies for research investments, deductions for income from patents, the "Young Innovative Companies" and the deductions for donations. However, federal indirect R&D subsidies of researchers will be under review according to the Government Agreement 2011. According to the OECD (2010), Belgium ranked 5th in terms of indirect (tax) subsidies in 2007 with €177.4m, and the federal tax R&D subsidies have increased to €460m in 2009. The total

[21] The BOF key is based on a number of output indicators related to education and scientific excellence – such as the publication output.

revenue foregone due to the R&D tax subsidy nearly doubles the share of the Federal Government in total public R&D funding.

While the main research and innovation funding measures at regional/community level tend to be of a horizontal nature, there has been a gradual shift to targeting a share of available funding towards specific sectors. At Federal level, this is clearest in terms of the focus on sustainable development, polar research and space research. At regional level, a number of specific measures or the setting up of thematic research centres or clusters have been a clear policy orientation. In Flanders, this has been done through the establishment of the four strategic research centres microelectronics (IMEC), environment (VITO), biotechnology (VIB) broadband technologies (IBBT), and two new knowledge centres on materials (SIM) and health (CMI); in Wallonia through the thematic competitiveness clusters, the mobilising programmes and more recently the programme for public-private partnerships and the WELBIO institute (in addition to the thematic applied research centres supported by the region); and in Brussels-Capital Region, a thematic focus is put on ICT, environment, and life sciences. While both Flemish and Walloon regions aim to foster public-partnerships, the success of their respective measures is somewhat below expectations. The new Concept Note Innovation Centre Flanders aims at integrating the different excellence centres into the six defined innovation Crossroads. For the Walloon competitiveness poles, mid-term evaluations for five clusters were provided for 2010 and they all provided positive but also several negative observations including lack of strategy, insufficient communication or lack of private funding.

Funding from the European level is an important source of research funding in Belgium, for instance, under FP6, Belgian researchers secured funding of close to €700m. From the total Structural Funds for Belgium over 2007-13 (€2,258b), Wallonia receives 61%, Flanders 32% and Brussels-Capital 4%. ERDF means will be spent on sustaining regional competitiveness and strengthening territorial cohesion (Brussels); promoting the science and innovation economy, stimulating entrepreneurship, improving the attraction for foreign companies and on urban development (Flanders); creation of companies and employment, development of human capital, sciences and research, and sustainable development of the region (Wallonia). In Wallonia, the total amount dedicated to research activities for the period 2007-13 represents €250m (ERDF plus contribution from the Walloon Region), which is an increase of 30% in comparison to the previous period (25% of these funds are dedicated to SMEs). One issue clearly for Wallonia, more than the two other regions, will be the impact of a reduction in total Structural Funds resources post-2013 on public research funding.

Another important source is FDI. Belgium has a strong presence of large foreign subsidiaries in the country: FDI intensity in Belgium increased from 5.7% in 2002 to 20.4% of GDP in 2008. Many of them operate also large R&D departments in Belgium; the share of industrial R&D by foreign owned firms is close to 60%.

Evolution and analysis of the policy mixes

The policy priorities and the mix of measures implemented by the Belgian authorities have not changed significantly over the last five years. Wallonia and Wallonia-Brussels Federation Research have published their first pluri-annual strategy Research 2011-2015 “Towards an integrated research policy”. For the rest, the emphasis has rather been on consolidating and expanding existing policy initiatives (for instance, strategic research centres in Flanders, Competitiveness clusters in

Wallonia, Impulse programmes and Strategic Platforms in the region of Brussels-Capital reinforcing the financing and restructuring of university researchers). At the same time, the three Belgian regions have continued to adapt and focus their policy effort to their specific institutional and economic environments. In Flanders, several initiatives have been taken in recent years in the field of renewable energy e.g. with the setup of ICleantech, Energyville, a testing ground on Electric Vehicles and the VEB (Flemish Energy Company).

The financial weight of the budget of the policy measures, as presented in the European Inventory of Research and Innovation Policy Measures, helps to shed light on the responsiveness of the policy mix to the structural challenges identified in Chapter 2. In terms of overall funding flows, the focus of the public sector is clearly on reinforcing the knowledge base, both in terms of investing in research infrastructure and research grants (in the higher education sector and strategic research centres) and on promoting scientific and technological careers.

In 2010 (see Bruno & Van Til, 2011), approximately two thirds of government intervention was focused on the broad field of research and technology representing €618m, out of which 33% for policy measures concerning excellence, relevance and management of research in universities; 30% for R&D cooperation (seven measures); and 30% for direct support of business R&D (11 measures).

The second main field is horizontal research and innovation policies (total of €254m) where more than 66% goes to strategic research policies (such as the federal research programmes, Strategic Research in Flanders, regional impulse programmes in Brussels-Capital, mobilising programmes in Wallonia or other such measures). The focus here is primarily on orientating the use of public R&D budgets towards societal issues and to some extent leveraging BERD through partnerships (challenge 2).

An on-going process of restructuring of the research potential continues at regional level with, for instance, the opening of new research centres such as the Flemish Centre for Medical Innovation (in 2010) and WELBIO in Wallonia (in 2009). The opening up of new research centres leads to competences in several areas, presumably attracting both researchers and companies.

Increasing the R&D budgets allocated to scientific research and improving the co-operation with industry clearly is the priority and receives the lion's share of public funding, about 8% of the estimated public budgets also aim at improving the overall quantity and quality of human resources for science and technology. As this calculation does not include the close to half-billion euro of annual foregone tax revenues (2010) from the Federal wage tax reduction for researchers, the policy-mix is clearly giving a significant emphasis to tackling challenge 3.

A number of measures aim at fostering research industry collaboration and commercialisation of research results (Challenge 4). The strengthening of research industry collaboration is promoted through new initiatives such as the Public-Private Partnership (PPP-2012) programme in Wallonia; in thematic strategic platforms in Brussels; and the "spearhead" policy in Flanders (and in addition the focus on societal challenges by way of 6 Innovation Crossroads as described in the Concept Note Innovation Centre Flanders of May 2011). Softer instruments primarily aiming at innovation support and management services also focus on Challenge 4, but are relatively smaller in budgetary terms with about 5% of the research and innovation policy funding allocated by the Belgian authorities. Similarly, the launch of the

programme Creative Wallonia in 2010 underlines the recognition by the regional authorities of the need to boost non-technological innovativeness in SMEs.

Finally, in terms of demand side innovation policies, although the Belgian authorities (collectively) have sought to use investment in space research (through the European Space Agency) as a form of pre-competitive public procurement, the use of public procurement to stimulate research and innovation is not yet widespread. However, 10 projects for sector specific knowledge investments through pre-competitive public procurement were defined in 2009 in Flanders[22].

In terms of related policies, the higher education sector has been undergoing changes in the framework of the Bologna process. This led to a partnership (or quasi-merger) of smaller HEIs (university colleges, autonomous faculties, third-level institutes) with one of the major universities in each Community. The commitment of the Belgian authorities to implementing the requirements of the European partnership for researchers is also strong. These process lead to higher compatibility of research and higher education with other EU countries and thus lowers barriers for mobility. However, language requirement and remuneration levels of researchers are de-facto barriers.

Finally, there is a strong and growing focus on environmental issues in Wallonia and Brussels-Capital and on societal challenges (such as health, energy, and eco-innovation) in all regions.

Assessment of the policy mix

Broadly speaking when assessing the policy mix, there is a need to keep in mind that while the Belgian research and innovation performance could be higher, in overall terms the country is firmly located in the top half of the 'league table'. Equally, despite concerns expressed in various reviews about 'co-ordination and synergies' due to the multi-level governance context, there are clear signs that the Belgian authorities have understood the need to optimise (if not rationalise) the public support provided via various governments and their agencies and to seek, where relevant, enhanced synergies.

As noted above, the policy mix and focus of policy effort has not changed dramatically over the last five years (and it could be argued over a decade). A considerable policy effort and corresponding investment has been made in reinvesting in scientific research (via the Federal Government and the Communities) and on enhancing the attractiveness of Belgium as a place to conduct both scientific research (the communities) and science-industry collaboration and commercialisation (the regions). At the same time, the targeting or strategic orientation of this investment has been subtly changing through a mix of competitive funding programmes and investments into thematically specialised research facilities and centres. The driving forces behind this specialisation are both economic (ensuring that the business sectors are assisted to reconfigure towards new competitive products or that new higher value added sectors emerge) and societal (e.g. dealing with environmental degradation nationally and contributing to tackling climate change globally).

The Belgian policy mix (at all levels) is sophisticated and the various authorities have put in place or further improved a mix of policy advisory and strategic intelligence

[22] A follow-up of the Flemish participation as project leader in a EU funded OMC project

actions that provide a stronger basis for policy decisions than existed a decade ago. Equally, the evaluation of policy outcomes has become an increasingly, if not systematically, applied tool to assist in improving policy effectiveness.

This said, the trends in research and innovation performance discussed above, and the evidence from benchmarking exercises such as the IUS, tend to suggest that the rate of improvement both in terms of increasing investment intensity and in terms of innovation performance are insufficient to meet the targets set in policy strategies. In particular, the following observations can be made.

- There is little chance of Belgium meeting the 3% GERD/GDP target even by 2020, even if the Belgian authorities have confirmed the 3%-target. The tax credits as well as other broader tax measures are adding funds to the research system, but are not counted in the calculations. Public investment is on slightly upward trend but even, for instance, the doubling of public investment in Wallonia over the last decade has only inched the region up to 2% GERD/GDP intensity. Even if the public investment gap with the EU-27 average was closed or surpassed, this would still leave a considerable gap of more than half a percentage point to be met by the business sector. Given current industrial structures, this is unlikely to happen. An obvious conclusion is that the Belgian authorities should be invited to reconsider their investment target for R&D and set a target that is achievable given the parameters of public finance and industrial structure that exist; or explain what additional measures they will take to meet the 3% objective.
- There is a need to be wary of hasty conclusions that the current policy mix is not working due to the lack of significant progress. Given the economic crisis over the last three years or so, the Belgium economy and research and innovation system appears to have 'weathered' the storm better than some other neighbouring countries. The introduction and extension of R&D tax reductions on researchers salaries (in both the higher education and business sectors) may very well have acted as an 'automatic stabiliser' without which R&D intensity would have declined rather than remaining relatively stable. Similarly, tax incentives for business such as the notional interests[23] measure may have contributed to maintaining the relative attractiveness of Belgium as a place to do research. This type of hypothesis requires validating and it would be timely to see an evaluation of the R&D tax measures to understand if they maintaining current or inducing additional R&D spend by the beneficiaries.
- The structuring of the higher education system (in both Communities) into larger institutions ('associations' or 'academies' bringing together several third level education institutes) should foster, if the correct policy incentives are in place, a corresponding realignment of research potential (e.g. greater scope for inter-disciplinary work or merging or pooling of research teams across

[23] The "notional interest deduction" enables all companies subject to Belgian corporate tax to deduct from their taxable income a fictitious interest calculated on the basis of their shareholder's equity (net assets). The main purpose is to reduce the tax discrimination between debt financing and equity financing. Indeed, in the case of loan capital, the interest paid is deductible from the taxable base, while with equity capital the dividends are taxable. These rules are intended to have the following positive effects: a general reduction of the effective corporate tax rate for all companies, and a higher return after tax on investment and the promotion of capital-intensive investments in Belgium; and an incentive for multinationals to examine the possibility of allocating such activities as intra-group financing, central procurement and factoring to a Belgian group entity.

formally autonomous institutes). This is one element that would help to reduce fragmentation of the overall Belgian research system and further improve its performance. At the same time, the balance between institutional and competitive funding of the system would merit further review in order to further focus and concentrate efforts. Finally, while the remit of the Federal Government to fund 'nation' wide research programmes has been further diminished (with the decided transfer of the inter-Community programmes Inter-University Attraction Poles and Technology Attraction Poles to the Communities and the Regions, there is a clear (financial at a minimum) rationale for organising joint programming, sharing certain research infrastructures or 'pooling' research efforts (e.g. the Scottish example of research pools could be applied) between Flemish, Brussels, Walloon and Wallonia-Brussels based research teams in certain fields. This has already been possible for coordinating Belgium's participation into research infrastructures of the ESFRI roadmap. It is to be hoped that the proposed Inter-Federal Plan for Research and Innovation will lead to concrete initiatives.

- The efforts to structure and develop major thematically, sectorally or technologically specialised 'clusters' of R&D and innovation over the last decade (and in the case of Flanders several decades) through strategic research centres, excellence centres, competitiveness poles, clusters and targeted research programmes need to be pursued and further consolidated. The evidence from the Flemish strategic research centres (IMEC, or VIB for instance) suggests that it may take over a decade before such initiatives become fully operational and realise their objectives, achieve 'critical mass' and attain international recognition. The Walloon competitiveness clusters and the research and technology centres created over the last decade will need sustained funding, regular evaluation and expert management if they are to begin to contribute effectively to structural adjustment of the economy. The realignment of research and innovation policies to contribute to tackling the structural adjustment of the economy or for taking on societal (grand) challenges such as the environment and climate change, will require better orientation and focus of the limited amounts of public funding available in the coming years with the need to possibly cut funding from non-priority centres or sectors. This implies the need for a political will to close or merge structures created over the previous decades.
- Aside from the Federal R&D tax measures, business R&D and innovation is supported via a range of measures managed by the regional authorities. The innovation policy mix has evolved over recent years but remains essentially based on grants (or reimbursable loans) for individual firms to undertake R&D. The IUS 2010 suggests (based on Community Innovation Survey (CIS) data) that the intensity of business innovation activity, notably non-technological innovation, is not improving and that the impact of such activity is not as positive as would be hoped in terms of boosting turnover from new products. Despite initiatives such as the VIS (Flemish Innovation Co-operation network) programme in Flanders or new coordinating agencies such as the Walloon Technological Stimulation Agency (AST) aimed at identifying and supporting firms with a potential to innovate more intensively, the situation has not evolved positively. There is a need for a further re-assessment of the effectiveness of the direct support measures and of intermediary support structures that are often over-complex and fragmented that would lead to a

more radical 'pruning' of the system to ensure value for money. In 2011, an update started of the report drafted by the Soete-commission in 2006 on the Flemish STI-landscape. The results have recently been published. At the current time, there is limited recent evaluation evidence on the effectiveness of the measures in place and a wide-ranging evaluation and review would be beneficial in each region in order to focus regional support on initiatives best able to contribute to raising the intensity of industrial R&D and innovation (including service sector and non-technological forms of innovation).

- Finally, the issue of public sector innovation is given a remarkably low priority in policy declarations or strategies, except for e-practices in all entities and public procurement for innovation in Flanders. Many observers would consider that the potential to increase the efficiency of public expenditure in Belgium and the effectiveness of services provided to the population is significant.

The table below summarises the policy response to the challenges identified in chapter 2 of this report.

Table 1: Challenges, Policy measures and assessment of appropriateness, efficiency and effectiveness

Challenges	Policy measures/actions[24]	Assessment in terms of appropriateness, efficiency and effectiveness
Increasing co-ordination and synergies within the governance system	December 2011 Federal Government Agreement foresees an inter-federal research and innovation plan March 2011 Strategy 2011-2015 (Framework note) on an Integrated Research policy for the Wallonia-Brussels Federation, Wallonia (and Brussels-Capital) The (national) interministerial council for science policy (uniting all ministers in charge of research) is addressing issues concerning improving national co-ordination as well as issues regarding a better co-ordinated approach towards Europe.	Recent assessments (e.g. ERAC peer review 2011) concluded that fragmentation hampers the effectiveness and efficiency of the Belgian STI system. The transfer of the PAI and PAT Federal measures further reduces inter-federal funding. Increasing integration and co-ordination of Walloon- Wallonia-Brussels Federation-Brussels-Capital policies with further actions foreseen by March 2011 action plan

[24] Changes in the legislation and other initiatives not necessarily related with funding are also included.

Challenges	Policy measures/actions[24]	Assessment in terms of appropriateness, efficiency and effectiveness
Under-financing of research	Government budgetary commitment to increase appropriations or refinance scientific research funds.	The various Belgium authorities have all increased public spending on R&D and are committed to continuing to do so. However, the public debt has increased and this places a strain, along with the financial crisis and growing unemployment on public budgets available for research. The structuring of public-private research efforts in the form of strategic research centres, competitiveness poles is a good step towards an embedding and attracting force for the large foreign R&D players. The high tax burden and relatively high labour costs remain a negative element for conducting research in Belgium. The tax credits are however reducing the wage costs for researchers with approximately 15 %.
Mobilising Human Resources for science and technology	Federal R&D wage tax reduction measures Range of measures at Federal, community and regional levels to support international mobility, industrial PhDs, recruitment of innovation managers, S&T studies	No robust data (yet) or evidence to allow a judgement as to whether the policy measures are paying off in terms of reversing brain drain or attracting more people to work in research or innovation careers.
Matching knowledge production with the economic fabric	Instruments include: Flemish strategic research centres and competence poles, Walloon Competitiveness clusters, support for business angels, regional risk capital measures, incubators and funding for university technology transfer centres	There is quite a comprehensive set of measures in place, targeting at interfacing between research institutions (incl. universities) and companies. Assessing the efficiency and effectiveness of these measures is out of scope of this report. However, there seems to be certain mismatch between knowledge production and the economy from a sector view point.

Nb: Please note that the list of policy measures is not extensive, as there are more than 75 measures in total

National policy and the European perspective

The key research and innovation challenges in Belgium are to increase synergies within the governance system, increase the financing of R&D of governments and the private sector, increase the financial attractiveness of research positions and the inflow of doctoral students and to match (policy instruments that stimulate) knowledge production with the economic fabric of the country.

The main routes forward to deal with the challenges are discussed and appraised in Section 3. In the section and table below, a further assessment is made of the alignment of the challenges to the Belgian STI-system and the European Research Area (ERA) dimensions – **elaborations on this assessment and table per dimension are to be found in the annexes.**

A main challenge as regards the labour market for researchers is the relatively low remuneration of researchers compared to comparable countries as well as a very low participation of women in research. To a certain extent also a mismatch may be identified in the supply and demand for high-skilled researchers and engineers: there are indications that there is a shortage of highly skilled engineers and scientists in the field of physics, chemistry and IT. Lastly, in an EU perspective, regional regulations prescribe the use of the community languages at HEIs, which is a barrier to foreign researchers.

With regard to cross-border cooperation, Belgium is strongly engaged in a range of European initiatives, as well as a range of federal and regional initiatives. These initiatives include bilateral agreements, joint-R&D projects and shared research infrastructures. Most instruments in innovation policy are however still relatively nationally/regionally oriented and not open to cross-border or cross-regional cooperation.

Belgium is quite strongly engaged in a wide range of international research infrastructure (RI) projects, while also strongly developing national and regional research infrastructures. Given the keen eye for the development of RI in Belgium, a challenge might be to look for further synergies in RI at cross-regional level.

With regard to the quality of research institutions, the quality is often hard to appraise as they are not yet systematically evaluated and monitored at federal level neither in Wallonia nor in Brussels. In Flanders, an evaluation culture has been emerging strongly in the last decade, e.g. all Strategic Research Centres have been evaluated in the last five years. The quality of research at HEIs is under pressure in Belgium, as in several other EU countries, due to the strong increase of students while funding is lagging behind this trend. In addition, Belgium has only limited competitive funding at HEIs - which might offer a further stimulus to enhancing the quality of research.

Belgium has quite a number of Public-Private partnerships (notably competence poles in Flanders, competitiveness poles in Wallonia). Many of these initiatives have not been subject to an external evaluation, or the results were not made public, which makes evidence-based assessment of these initiatives hard. However, in Flanders the instrument has recently been subject to change: competence poles are now ‘light structures’, which should enhance synergies between public and private partners and enable more transparent governance. In this light, the performance of the new competence pole is measured via Key Performance Indicators (KPIs) and funding depends on these KPIs. A final challenge remaining may be the integration and search for synergies at Belgium level, as competence poles have a relatively high regional character. Particularly noteworthy is the recent opening of Walloon competitiveness poles to Brussels stakeholders.

Knowledge exchange with EU partners is given strong emphasis at a regional level. Flanders has a number of cooperations in Dutch-Flemish context and with Nordrhein-Westphalia in the field of sustainable chemistry and microtechnology, whereas Wallonia and the Wallonia-Brussels Federation has developed cooperation mainly with neighbouring countries and French-speaking areas.

International cooperation in Belgium is relatively well developed and in this regard the most apparent challenge is to further work towards a more integrated approach at the national level, by coordinating the scattered initiatives at regional level.

Table 2: Challenges to the national policies/measures supporting the strategic ERA objectives (derived from ERA 2020 Vision)

	ERA dimension	Main challenges at national level	Recent policy changes
1	**Labour Market for Researchers**	• Relative weakness in HRST, high demand for qualified science, engineering & technical employees; • Low incentives to become researcher due to low career perspectives and relatively low salaries. • Relatively low female participation in research • Still nationally/regionally oriented market for researchers, e.g. due to language restrictions	Only marginal change since 2011. Several Action plans are being adopted/ implemented to improve the position of researchers. Belgium is committed to implement the European Charter for Researchers. Federal tax breaks for recruitment of researchers maintained.
2	**Cross-border cooperation**	• Need to maintain human resource base; • Need to improve national critical mass by fostering intra-regional cooperation • Further need to open up the instruments, developing cross-border initiatives	No significant changes. All authorities involved in European and inter-regional co-operation initiatives in field of research and innovation. Internally, better cooperation between Wallonia and the Brussels-Capital region.
3	**World class research infrastructures**	• Need to maintain Belgian participation in international infrastructures (e.g. Princess Elisabeth station in Antarctica) • Need for cross-regional cooperation and alignment of research infrastructures	Federal Belgium coordinating ESFRI MYRRHA project. Flanders: Approved participation to 4 ESFRI projects (ICOS, LIFEWATCH, ESSurvey, SHARE) over 20-25 years. Budget: €3.5m in 2012 Wallonia: €4.4m dedicated to the participation in the PRACE project in 2011 Wallonia + Wallonia-Brussels Federation: Approved participation to the same 4 projects.+ PRACE + BBMRI Budget: ~€6 m in 2012

	ERA dimension	Main challenges at national level	Recent policy changes
4	**Research institutions, including HEI**	• Quality of HEI as Research Institutions under pressure due to faster increasing number of students increasing than personnel at HEIs • Relatively low levels of competitive funding • Relatively weak monitoring and evaluation systems in place at federal, Wallonia, Brussels level	Flanders: Renewal of the Management Agreements with several (strategic) research centres (Imec, VIB, IBBT) Wallonia-Brussels Federation Wallonia to undertake an inventory of research equipment and (middle-class) infrastructure in 2012 On-going reflection on the structuring of applied research centres in Wallonia
5	**Public-private partnerships**	• Several stimulating programmes with low interaction levels at system level. Although financing of HERD by the business sector is typically high, the synergies at Belgian level between all PPPs are rather low.	Flanders: alternations of the competence pole scheme. Set up of a new competence pole: FISCH Wallonia: new PPP project call launched in 2011.
6	**Knowledge circulation across Europe**	• Lack of coordination of regional policies at national level – so far only individual initiatives at regional level	No changes
7	**International Cooperation**	• Limited authority of federal level and a lack of coordination between regional/community initiatives at national level.	No changes

The newly formed federal government (November 2011) has reinforced the basic political division of labour between the federal and regional/community sections. As the Federal Government retains most of the competences for fiscal measures, decisions taken at federal level can influence the community and regional research and innovation policies, in particular when it comes to tax deduction schemes.

Given the problematic financial situation and the political will to arrive at a balanced budget in 2015, several austerity measures were already taken. It is positive that tax deductions and other fiscal measures to support R&D are continued under the new Federal Government. Under review are, nonetheless, indirect subsidies of researchers ('wetenschappelijke Maribel' or 'Maribel scientifique'). Also in terms of research infrastructures, current involvements are under review such as the Belgian investments in the Antarctic, including the maintenance of the Princess Elisabeth station.

In general, the Belgian authorities are strongly committed to and participate in European initiatives. In a number of cases this commitment matches national/regional challenges or priorities. For instance, the steps taken to implement the European Partnership for Researchers should make it easier to attract and retain qualified human resources.

Annex: Alignment of national policies with ERA pillars / objectives

1. Ensure an adequate supply of human resources for research and an open, attractive and competitive single European labour market for male and female researchers

1.1 Supply of human resources for research

In terms of human resources for science and technology (HRST), Belgium demonstrates a slowly increasing absolute number of HRST. In 2010, 700,000 HRST were counted for Belgium, an increase of 20,000 from 2009. As a share of the labour force for the 25-64 age groups, Belgium increased its share continually. In 2010, the share reached 49.3% (EU 40.5%). Belgium shows a strong relative performance with a high level of education of the active population and investments in higher education superior to the EU average. However, there are indications of an imbalance in the demand and supply of qualified personnel in Belgium, notably in a context of increased specialisation. In terms of research professionals, for example, Labour Force Survey data for 2011 show a decrease. If one takes the average annual growth rates between the period 2008-2011, Belgium records a decrease by -0.8% compared to the EU-average of 3%. Also its neighbouring countries show positive trends such as the Netherlands with 3.8%, France (6.5%), Germany (7.3%) and Luxembourg with 13.7%. The share of new science and engineering graduates among new tertiary education graduates is also well below EU-27 average (16.3% against 22% in 2009). Another indicator that is not improving since years is the share of the population aged 25-64 participating in life-long learning, which is also well below EU-27 average (6.8% against 9.3% in 2009). When looking at the share of HRST by occupation of the active population (25 to 64 years), the share of foreign HRST increased in absolute numbers from 68,000 in 2005 to 86,000 in 2009. 88% are from other EU countries. The non-nationals HRST made up 9% of all HRST in 2009, however, their growth rate is higher than for the Belgian ones (6% versus 1.6% for 2005-2009). Looking at the share of foreign students at tertiary level, Belgium stands above the EU-27 average with 10.5% in 2007 (Eurostat). In Flanders, a recent survey of junior researchers (doctorates) and data of Flemish universities show that 17% of researchers are foreign; half of whom come from an EU country. The share of foreign researchers declines strongly with increased seniority. Only 5% of professors are foreign, against about 30% of postdoctoral researchers. Statistics are not available on the outward flow of researchers. Public discourse suggests that especially young talented researchers pursue their career in foreign countries due to a shortage of junior research positions (De Standaard, 2010).

There are a number of schemes for international mobility at federal, regional and community level but, there is not a single internationalisation strategy in place. In Flanders, there is a certain guiding effect to international mobility, aiming at (re)attracting senior researchers. Moreover, there is a range of smaller instruments that promote exchange and (temporary) outward mobility in a context of learning. In Flanders, the rather ad-hoc strategy is developed in the Action Plan for researchers (EWI, 2010). In Wallonia-Brussels, the Action Plan adopted in May 2011 under the name 'Wallonia-Brussels Partnership for Researchers' is composed of 25 actions organised in six chapters, where public authorities undertake, alongside the actors in research, to place researchers at the centre of the priorities given to the consolidation of research as a driver of the future: Open recruitment and portability of subsidies; Social security, tax system, visas and other matters falling under federal authority; Employment and working conditions; Training of researchers; Gender equality; and Access to Job Market for PhD Holders.

1.2 Ensure that researchers across the EU benefit from open recruitment, adequate training, attractive career prospects and working conditions and barriers to cross-border mobility are removed

Belgium does not offer the best working conditions for researchers (CARSA, 2007); but puts effort into improving this by new policies and dedicated budgets. Belgium has recognised the European Charter for Researchers and the Code of Conduct for the Recruitment of Researchers as a good basis for improving researchers' career prospects. Given their high autonomy, the research institutions play a pivotal role in the implementation of the Charter. Ten main institutions signed the Charter, including the F.R.S-FNRS

and the Rector's Conference of the French Community, the Flemish universities and the Flemish Research Foundation FWO. The actions of the French and Flemish Communities are in line with the Charter and aim to improve the objectivity and transparency of decision making on recruitment and researchers career paths, including equal opportunities.

The level of salaries of academic staff in research organisations are established by law for the federal scientific institutes (FOD Justice 2008), for the F.R.S-FNRS and for the Flemish research institutions. According to the report Remuneration of Researchers in the Public and Private sectors (CARSA, 2007) the total yearly salary average of researchers in Belgium is relatively high (€55k/a in 2007, which is 46% higher when compared to EU25 and associated countries average – corrected for PPS (CARSA, 2007). Nonetheless, since social contributions in Belgium are amongst the highest in Europe, take-home pay of qualified employees is relatively low compared to competing countries (€26ka/a, only 6% above EU-25 and associated countries average). Remuneration is increasingly recognised as a barrier to retaining and attracting skilled labour. Therefore, a number of tax incentives were set up to decrease loan costs recently, specifically aiming at R&D knowledge workers.

The focus on the use of French and Dutch languages in the research grant systems for PhDs can be regarded as a barrier to mobility. The OMC peer-review of Belgium (Verbeek, 2007) highlights that language restrictions hamper 'rejuvenation', as it is a barrier for inward mobility. Therefore the research system is not yet internationally oriented: in Flanders for instance, most jobs are still announced in regional media only; however, increased use of EURAXESS can be observed. A review of the Flemish STI system (Soete, 2007) strongly suggested loosening the Flemish Language Parliament Act. The Flemish Council for Science and Innovation recommended a less strict Flemish Parliament Act. However, using English in education is a sensitive matter in the country, as the language legislation in Belgium is well defined, and it is an important cultural discriminating factor between the different Communities.

The F.R.S.-FNRS and FWO are amongst the participating organisations of the initiative EUROHORCs. In order to remove mobility barriers for European researchers, EUROHORCs partners agreed on authorising researchers moving into partnering countries to take with them the remainder of a current grant. Grants of the IWT cannot be footloose: as it is the goal of IWT to strengthen innovation performance of Flanders, the research is principally done in Flanders. Only EU inhabitants and companies (active inside and outside Belgium) are eligible for IWT grants. In Wallonia, only companies with an establishment in Wallonia are eligible to regional grants whereas all French-speaking universities can apply.

Academic staff are employed by universities, which have a high degree of autonomy in their human resources policies. There is no national legislation that regulates the (access to) permanent research positions and that helps or hinders the openness towards non-nationals, but at the Community level the following actions are planned with regard to the European Partnership for researchers such as simplification of procedures and better use of EURAXESS by opening job offers and improving the Belgian site. With a view to opening up recruitment, Belgian research vacancies supported by public funds are advertised internationally on the European Researcher's Mobility Portal, and non-nationals are eligible in competition for permanent research and academic positions.

1.3 Improve young people's scientific education and increase interest in research careers

According to the 2009 PISA results (OECD 2010), Belgium is among the countries with a high variability in student performance between schools. Broken down by Community (Flemish and French) the results showed a relatively poor performance for the French Community educational system in mathematics and sciences. Since Belgium is a consociational[25] democracy (Seiler 1997, Mangez 2010), the education system largely comprises a wide range of public, subsidised private and private schools. Mangez (2010) argued that these types of consociational societies are unlikely to generate knowledge-driven policy communities and, due to globalisation, the need to change curricula has become important. In the Belgian context this transposition of guidelines is however following the values and cultural references of

[25] Consociationalism is a form of government involving guaranteed group representation, and is often suggested for managing conflict in deeply divided societies. It developed on the basis of reconciling societal fragmentation along ethnic and religious lines.

each community. The changes in educational policies in the Flemish Community lead to a stronger role of the state (de Rynck, Dezeure 2006). In Flanders for example, but also in Wallonia-Brussels Federation the schools are quality controlled by the Ministry in charge of Education. Among the quality criteria are attainment targets such as knowledge, insight, attitudes and skills. Flanders has pursued a policy since 1996 to stimulate ICT in education. The French Community introduced a strategic plan in 2002 and in 2003 the initiative "Passeport TIC" for ICT use in primary and secondary education was introduced. Whether aspects such as creativity, critical thinking, problem solving, teamwork, and communication skills are included in the curricula is not known. There is no information source that covers all Belgian curricula.

Acknowledging the need to promote scientific studies among young people and the added value of conducting a joint action on this topic, the Wallonia-Brussels Federation, the Walloon Region and the Brussels-Capital Region have launched a joint call for micro awareness-raising projects in 2011 called 'Later, I will be Einstein or Marie Curie'. A second call will be launched in 2012 (max budget per project is €5,000).

1.4 Promote equal treatment for women and men in research

According to She Figures 2009, Belgium ranks among the five poorest performing countries for equal opportunities: there are only 38% of female Ph.D. graduates (EU-27 average: 45%), 11% of Grade A positions were filled with women (EU-27 19%) while at Grade B (for researchers higher than newly qualified PhD holders) only 25% are women against 36% in the EU-27 average. Women in science tend to have a 32% lower salary (European Commission, 2007). While in the Flemish and in the Wallonia-Brussels Federation, more than 50% of the university students were women in 2008, only 22% of the academic staff were female in the French Community universities and only 15% in the Flemish Community (CREF, 2010). In Flanders, the career progress for women seems to be particularly precarious with only 19.6% of female senior researchers against 53% of female junior researchers (VLIR, 2009)[26]. Flanders adopted the Open Method of Coordination (OMC) approach; the university council VLIR has set up an equality policy and working group to improve the position of women in science. In the Collective Labour Agreement for universities several agreements have been made to reduce the negative effects of career breaks on women's research careers[27]. Career breaks such as maternity leave do not impose a regulatory threat to the women's career; nevertheless, pregnancy is still identified as a 'competitive disadvantage' (VLIR, 2008).

Labour law and rules are not only affecting researchers but all other labour market participants. In this respect, the Government Agreement of 1.12.2011, the basis for the new federal government, states the extension of anonymous curriculum vitae for applications in the public sector (first round). A specific law will also be established concerning equal pay.

2. Facilitate cross-border cooperation, enhance merit-based competition and increase European coordination and integration of research funding[28]

Actions supporting mechanisms such as joint programming and other jointly funded activities are available, but they are not numerous. The Flemish Government actively participates and co-finances international joint-projects such as ERA-NET projects, 'Article 169-initiatives' and two Joint Technology

[26] Sources: Wallonia (CREF, 2010), Flanders (VLIR, 2009); analysis by Technopolis Group

[27] It is forbidden to terminate a permanent employment contract and prematurely terminate a fixed term employment contract during pregnancy or during the period in which the employee is on maternity leave, or during a period of six weeks after resuming work or a period of incapacity for work as a result of the birth or the preceding pregnancy following maternity leave.

[28] Promote more critical mass and more strategic, focused, efficient and effective European research via improved cooperation and coordination between public research funding authorities across Europe, including joint programming, jointly funded activities and common foresight.

- Ensure the development of research systems and programmes across the Union in a more simple and coherent manner.
- Promote increased European-wide competition and access of cross-border projects to national projects funding

Initiatives (JTI). Belgium thus takes part in ARTEMIS (IMEC, DSP Leuven) and ENIAC[29]. Moreover, Belgian actors are involved in the JTI Clean Sky, as well as member of the European Technology Platform ISI (The Integral Satcom Initiative). Belgium is also active in the JTI FACCE[30] and will join the URBAN EUROPE initiative in 2012.

Wallonia actively participates in several ERA-NET initiatives co-financing projects by according grants to regional R&D performers in consortia (€6.8m in 2010 and €5.9m in 2011) and takes also part in the Eurostars initiative (art.185 initiative) (€3.2m in 2010 and 1.4m in 2011), where up to €1.5m is exclusively directed towards Walloon SMEs. Flanders is also participating in EUROSTARS: project subsidies for participating in the EUROSTARS programme can be obtained from IWT. The F.R.S-FNRS also takes part in several ERA-NET initiatives. The region of Brussels-Capital also disposes of special funding for the EUROSTARS/ EUREKA programmes .

Opening up of R&D programmes is slowly emerging in Belgium, though most R&D programmes are still relatively closed. Opening up of programmes is mainly visible at Federal level. In addition to the federal programme in space research and a few international programmes, all federal research programmes are open for participation of research teams of EU Member States (with a limit of 50% funding).

All communities (and regions in the case of applied research) provide subsidies for research projects carried out in international teams, either to support preparation of such projects through lump-sum grants, or in the form of an augmented subsidy rate for projects with international participation.

Several measures exist to attract Belgian researchers who settled abroad: return mandates form the federal level, scientific impulse mandates - ULYSSE from the French Community (F.R.S-FNRS) and Odysseus in Flanders as well as measures in the Brussels-Capital region (‘Brains Back to Brussels’, ‘Research in Brussels’). One can nonetheless highlight that this co-existence of mobility schemes in all Belgian entities might play against the external visibility of the country for foreign researchers. This might be one of the entrance points where a coordinated approach between Belgian entities could have large added value (see also CWPS, 2010).

The F.R.S-FNRS also proposes short-term (three years) positions and grants to non-national PhD holders coming into a university lab within the French Community. In 2008, a new grant programme has been set up by WBI, which sets out to reflect the themes of the competitiveness clusters. It is designed to allow universities of the region to host university students from institutions of excellence abroad, whatever countries. A similar programme exists for graduates from Wallonia and Brussels who wish to study in a university of excellence abroad.

In Wallonia, the scheme FIRST International allows Walloon companies and research centres to collaborate with foreign research organisations, which will host a researcher for a minimum of six months. Nonetheless most of the Walloon programmes remain open to Walloon stakeholders only. Only recently, some programmes were opened to partners of other Belgian regions, most notably the competitiveness poles. A member of Enterprise Europe Nework, "Enterprise Wallonia Europe" is a consortium launched in 2008 that brings together ten local organisations dedicated to helping regional business get information and advice, to compete effectively in Europe.

In the region of Brussels-Capital the Enterprise Europe Nework network hosted by the Brussels Enterprise Agency provides a guidance, networking and orientation to SMEs wishing to collaborate at international level.

In Flanders, internationalisation is framed in a broader perspective than innovation only; it aims at “internationalisation of the Flemish economy”[31]. The Flemish Agency for International Entrepreneurship “Flanders Investment and Trade” for instance, has a budget of almost €15m available for financial support to internationalisation of SMEs, which includes co-operation in STI. Moreover, specifically aiming

[29] ENIAC is a large scale, applied-research initiative mobilising European efforts in the technology-intensive electronics sector. The main goal is to define the research and innovation priorities to ensure a truly competitive nanoelectronics industry in Europe.

[30] FACCE brings together 67 research groups from 17 countries and aims to improve the characterisation of European food security due to climate change and to enhance adaptation capacity through improvements in modelling of impacts of climate change. The total costs are estimated at around €15m.

[31] Cf. Chapter 1.6 of the Budget Browser (EWI, 2011).

at RDTI, Flanders offers the Enterprise Europe Network that aims at stimulating international co-operation via networking, brokerage and raising awareness. Several research programmes aiming at talented researchers provided by FWO are open for foreign researchers. FWO received additional funding for 2012-2016. The fund for financing of non-oriented research in universities (BOF), which received an additional €7m for 2012-2016 can be used for participation in international research projects. FWO's Odysseus programme received €3m for projects aimed at attracting foreign top researchers. A new initiative is Pegasus, aimed at the participants of FP7 Marie Curie grants. In addition to these schemes, several R&D programmes of IWT are opened up to foreign co-operation, such as SBO (up to 20% of the funding) and the excellence centres. As it is the goal of IWT to strengthen the innovation performance of Flanders, the research needs to be performed in Flanders, unless there is a Flemish benefit of including a foreign partner.

3. Develop world-class research infrastructures (including e-infrastructures) and ensure access to them

The financial participation fees to research infrastructures (RI) are covered by the federal government, but regional authorities are involved to increase the support.

On November 14, 2011, the Interministerial Conference for Scientific Policy which gathers the Federal Government and the Governments of Regions and Communities adopted a list of priorities involving participation in 31 international research infrastructures in Life Sciences, Social Sciences, Humanities, Environmental Sciences, Energy and e-Infrastructures[32] within the context of the European Strategy Forum on Research Infrastructures (ESFRI). The Interministerial Conference for Scientific Policy has decided Belgium's fast-track accession to PRACE, SHARE-ERIC, ESS-ERIC, LIFEWATCH-ERIC and ICOS-ERIC in 2012. Besides this, the Federal Government's main contribution is as lead partner on the MYrrHA (Multi-purpose hybrid Research Reactor for high-tech applications), one of the research infrastructures presented in the 2010 ESFRI roadmap, a European Fast Spectrum Irradiation Facility. Belgium will contribute 40% of the €960m construction costs as part of a broad international consortium[33].

The ministers in charge of research are debating a national approach regarding the participation in the ESFRI roadmap with a clear division of responsibilities and guiding rules. Flanders is co-operating in four ESFRI projects[34] (ICOS, LIFEWATCH, ESSurvey, SHARE) over 20-25 years, for a budget of €3.5m in 2012. The Wallonia-Brussels Federation and Wallonia approved their participation to the same projects in addition to PRACE (€4.4m are dedicated by Wallonia to the participation in the PRACE project in 2011) and BBMRI, for a budget of €6 m in 2012.

At regional level, there are specific measures that finance research infrastructure investments (such as, for instance, the Hercules Fund in Flanders and the Athena Budgets managed jointly by Wallonia and Wallonia-Brussels Federation since 2011). In particular, the regional Flemish investments in research infrastructures are significant: the Hercules Fund for large infrastructures received €5m additional funding for 2012-2016. Moreover, the Finance Fund for Paying of Debts and Investments (FFEU)[35] also aims at research infrastructures, it invested for instance €45m in the marine (VLIZ), energy and environment (VITO), ICT (Flemish Supercomputer Centre), medical (VRWB) and educational infrastructure. In line with the new Research Strategy 2011-2015, Wallonia and the Wallonia-Brussels Federation have set up the Athena fund in 2011 with a joint budget of €6m for research infrastructures.

According to the European portal on RI[36], the Belgian RI provide essential resources, at a high cost. They are open to external researchers and have a clear European dimension and added value. Table 4 gives an overview of Belgian RIs.

Table 4: Main Belgian research infrastructures

[32] http://www.belspo.be/belspo/coordination/euCoor_Infra_en.stm

[33] http://myrrha.sckcen.be/

[34] i.e. LIFEWATCH and CLARIN

[35] Financieringsfonds voor de Schuldafbouw en Eenmalige Investeringsuitgaven (FFEU)

[36] http://www.riportal.eu/public/index.cfm?fuseaction=ri.result

Name	Main scientific domain	Category	Main institution
BEgrid	ICT, Mathematics	GRID computing facilities	BELNET, Brussels
Micro-nano experimental facility of the CeRMiN	Material Sciences, Chemistry & Nanotech.	UCL	Université catholique de Louvain, Louvain-la-Neuve (Wallonia)
Time resolved pico- and femtosecond emission and absorption spectroscopy	Life Sciences	Mass spectroscopy and other analytical facilities for life sciences	Division of Molecular & Nanomaterials, Chemistry Department K.U.Leuven (Flanders)
VAR - Veterinary and Agrochemical Research centre	Life Sciences	Animal quarantine stations & experimental farms	Veterinary and Agrochemical Research centre, Brussels
HADES	Physics and Astronomy	Underground labs	EIG EURIDICE, Mol (Flanders)
European Anglers' Alliance	Environmental, Marine & Earth Sciences	Other Marine RI	European Anglers' Alliance, Brussels
The BR1 Research Reactor	Energy	Nuclear energy RI	SCK-CEN, Mol (Flanders)
VENUS: Zero Power Research Reactor	Energy	Nuclear energy RI	SCK-CEN, Mol (Flanders)
Nanoelectronics Laboratories	Material Sciences, Chemistry & Nanotech.	Micro- and nanotechnology facilities	IMEC, Leuven (Flanders)
Cyclotron Research Centre	Physics and Astronomy	Nuclear Physics accelerators & detectors	UCL, Louvain-la-Neuve (Wallonia)
Royal Belgian Institute of Natural Sciences (RBINS)	Environmental, Marine and Earth Sciences	Natural History collections	RBINS, Brussels
EMAT (ELECTRON MICROSCOPY FOR MATERIALS SCIENCE)	Material Sciences, Chemistry and Nanotechnologies	Electron microscopy facilities	EMAT, University of Antwerp (Flanders)
Ion and Molecular Beam Laboratory (IMBL)	Material Sciences, Chemistry and Nanotechnologies	Surface science RI	Instituut voor Kern- en Stralingsfysics, K.U.Leuven (Flanders)
Royal Museum for Central Africa	Humanities and Behavioural Sciences	Archaeology & Anthropology databases/collections/ repositories	Royal Museum for Central Africa, Brussels
Constitution de bases de données textuelles et dictionnairiques latines	Humanities and Behavioural Sciences	Literature and text archives	CTLO (Centre Traditio Litterarum Occidentalium) Turnhout (Flanders)

Name	Main scientific domain	Category	Main institution
Aeronautics & Aerospace Department	Engineering	Wind tunnels	von Karman Institute for Fluid Dynamics, Rhode-Saint-Genese (Flanders)
RV Zeeleeuw	Environmental, Marine and Earth Sciences	Research vessels	Flanders Marine Institute - VLIZ, Oostende (Flanders)
National Botanic Garden of Belgium, Seed Bank	Life Sciences	Seed banks	National Botanic Garden of Belgium, Brussels

Improved coordination at national level could lead to more critical mass at this level. Bundling of initiatives for example in computing could lead to a stronger Belgian position, thus leading to win-win situations for all regions involved.

4. Strengthen research institutions, including notably universities

Universities are independent organisations and their legal status ensures close to full autonomy. They are responsible for both their research and education strategy[37], they hire their own staff and award diplomas independently within the regulatory limits. Rectors of universities have to be full professors and thus fully employed by the university. In Flanders as well as in the Wallonia-Brussels Federation, the academic personnel of a university select the rectors. In the Wallonia-Brussels Federation the rector is appointed by the Government for a term of four years based on a list of three full professors presented by the Academic Council. In the Flemish community, the academic personnel of a university select the rectors.

The Communities are responsible for higher education, including institutional funding, competitive funding across universities and support to individual researchers. There are two separate university systems, consisting of (i) six Wallonia-Brussels Federation universities (including two in Brussels) and 21 university colleges (‘*hautes écoles’*); and (ii) six universities and 22 university colleges (“hogescholen”) of the Flemish Community, in the Flemish and the Brussels Capital regions. Following the Bologna Agreement, linkages and synergies between universities in the Belgian communities are growing. In order to create more critical mass and to enable students’ mobility between universities and university colleges they are now structured into three academies (Wallonia-Brussels Federation) and five associations (Flanders)[38]. Since 2007 the Wallonia-Brussels Federation is allocating funding directly to academies in the framework of the concerted research actions and the Special research fund. Academies are responsible for distributing funds through their members and to organise collaboration between them.

The main aim of the community funding for research at universities is to realise high quality fundamental research and provide tertiary education. HEI policy is not thematically organised. Instead, the communities leave the thematic choices to the researchers and focus on the quality of scientific research to support. There are three further principles to which the communities contribute, namely: promoting inter-university cooperation; promoting international mobility of researchers; and including research in the European Research Area. In Flanders the mission of the HEIs can be summarised as performing scientific education, research and fulfilling a social function[39]. In the Wallonia-Brussels Federation those missions consist of providing high quality initial and continued teaching, participating in research and/or creative activities and providing services to the community, particularly through collaboration with the educational, social, economic and cultural worlds[40].

[37] However, in Flanders they are not fully autonomous in all decisions of educational matters

[38] Wallonia: Louvain, Wallonie-Bruxelles and Wallonie-Europe; Flanders: Leuven, Antwerpen, Gent, Hasselt, Brussels

[39] By decree: Gedr. St. Vl. R. 1994-95, 615, nr. 3, 5. Art. 3 of decree (B.S. 31 Augustus 1994)

[40] Art. 3 of decree of 31 March 2004 “Décret définissant l'enseignement supérieur, favorisant son intégration dans l'espace européen de l'enseignement supérieur et refinançant les universités”

In the Wallonia-Brussels Federation, block funding for HEIs is allocated on the basis of the number of students and full-time equivalent researchers – the allocation of block funding is not allocated based on scientific performance indicators such as bibliometrics. In Flanders, additional funding for universities is also distributed based on an allocation key, which is partially based on scientific output indicators[41]. All in all, the share of competitive funding in Belgium is relatively low; its increase could therefore give an additional incentive to universities to reach a high level of excellence in knowledge production.

Research performance of HEIs/PROs is not systematically monitored in Belgium. Quality control is performed at the level of the Communities. In Flanders, a Dutch-Flemish accreditation body carries out systematic review – but this is primarily focussed on education. Educational quality is monitored proactively, in consultation with all parties involved, and with increasing attention to the results of various external analyses and audits. The Flemish Expertise Centre for R&D Monitoring (ECOOM) monitors the scientific progress of the Flemish region as a whole. In their official monitoring reporting[42] the data is not broken down to individual institutes. Targets for the scientific progress of the most significant PROs in Flanders are laid down in the Management Agreements of these PROs. These PROs are evaluated every five years, including a peer-review, bibliometric and socio-economic analysis. Executive summaries on the results of such evaluations are publicly available. In general, the evaluations conclude that the scientific level of the SRCs is above the level of the benchmark. A main challenge lies in the valorisation of knowledge of the SRCs by industry and society.

Within the Wallonia-Brussels Federation, the independent public sector agency for the evaluation of the quality in the HEI (AEQES) is the responsible unit. The agency is in charge of the policies and guidelines concerning the external evaluation of programmes at universities, “hautes écoles” (non-university HEIs), art academies and conservatoires, higher institutes of architecture and adult learning institutions. It formulates a ten year evaluation programme and diffuses best practices. According to the list of indicators used for evaluations, scientific results do not play a role, even if the level of synergy between research and teaching activities are duly evaluated. The short conclusions of the evaluations are publicly available.

In the past three years, no significant changes were made to the higher education system. Nonetheless, in Wallonia, a reflection is on-going on the structuring of the 22 applied research centres which are accredited by the region. The objective is to reduce their number over time in order to reach critical mass.

5. *Facilitate partnerships and productive interactions between research institutions and the private sector*

The joint execution of research projects appears to be the most direct method for the transfer of technology between universities and industry, so that the knowledge and expertise present in the universities can be valorised as far as possible for the benefit of the regional economies. This is organised in a range of measures, such as the strategic basis research facility provided by Innovation Agency IWT in Flanders.

Inter-sector mobility is stimulated indirectly via the increased use of programmatic funding for competitiveness poles in Wallonia, excellence centres (or competence poles) in Flanders, and strategic platforms in Brussels. These poles or centres include public-private interaction to increase inter-sectoral mobility.

In Flanders, the excellence centres have had variable success. The most apparent failure of the excellence centres is that a number of these are not able to raise sufficient levels of funding from industry to provide for themselves. In December 2011, a new excellence centre FISCH was approved, dedicated to sustainable and bio-based chemistry, and building on the SUSCHEM Flanders initiative. Upstream to the supply of knowledge, Flanders also facilitates four strategic research centres. Three out of four have been granted a renewed and extended Management Agreement in December 2011 after (minor) revisions based on external evaluations (imec, VIB, IBBT). In 2012, VITO will be evaluated. Moreover, in

[41] i.e. publication - The BOF key is based on a number of output indicators related to education and scientific excellence – such as the publication output

[42] The so-called Indicatorenboek, ECOOM (2011)

the course of 2010-2011 two new knowledge centres were started, the Strategic Initiative Materials (SIM) initiative and the CMI[43] initiative. In order to support inter-sectoral mobility, the Baekeland Mandate in Flanders offers funding for projects at the interface of companies and knowledge institutes. The Policy Note 2009-14 points to mobility as a weakness in research careers in the Flemish system.

In Wallonia, the Public-Private Partnership (PPP-2012) programme has been focusing on the five thematic fields of the 2011-15 research strategy: sustainable development, energy, technological research, health, ageing and quality of life. In addition, public-private research partnerships in cross-cutting fields of the five strategic themes and the six areas covered by the competitiveness clusters, which combine companies, training centres and public and private research units, will also be prioritised. Regional funding is aimed at leveraging additional private sector funding to invest in higher education (university)-business research projects. Through its mobilising programmes, the region is aiming to improve the scientific potential of its universities and schools of higher education in industrial fields essential to the region and to bring them into the fabric of Walloon industry. Industry-science schemes like the FIRST schemes, consisting in the transfer of personnel between academia and industry, are also an important instrument of the regional policy-mix. In the region of Brussels-Capital, the Spin-Off in Brussels programme also supports the launch of spin-offs and the programme DOCTORIS was set up in 2011 to facilitate doctoral studies in enterprises and universities. The strategic platforms cover the field of academic research with a clear focus on industrial applications for the region, following consultation with the local companies of the sector.

The Belgian regions fund knowledge transfer offices (the so-called interface structures) at universities and other HEIs located on their territory. Interface structures have the mission of stimulating external contacts at the universities.

Since 1998, the Walloon government also supports the reinforcement of the university-industry interfaces with specialised personnel in charge of fostering the valorisation of research results in industry. The DGO6 provides financial support to a total of 11 persons in charge of valorisation at the universities and university colleges. These persons usually work within the research management department of their institution. They are in charge of identifying the ways to exploit research results with commercial potential as well as managing the intellectual property strategy. Interface support is, since 2006, coordinated as a key action of the technological promotion agency (AST), which brings together more than 50 structures acting as intermediaries between the industrial and the academic world.

The Brussels-Capital region supports the interface technology transfer offices of three universities as well as the Indutec interface that gathers together the four university colleges of the region. Each interface structure receives a contract that defines missions and duties, and reports to the region according its terms. The regional authority deals with funding application of interface personnel while the universities and university colleges themselves carry out the work with interfaces. In terms of IPR, the universities as employers own the rights of any patentable invention coming out of the research of their employees.

Quantitative evidence is not available on inter-sectoral mobility. Nevertheless, remuneration issues probably hamper mobility from public research institutes to the private sector. The remuneration package of senior academic personnel from public institutes differs significantly from that of the private sector. On average the package of an academic teacher is at 75% of the average wage. Professors reach the remuneration ceiling quite quickly; the maximum remuneration is at 85% of the average wage and decreases to 60% for first-class academics. Moreover, trends are negative: the evolution of the wages of researchers did not change significantly over time, while the private market wages increased slightly more than the inflation rates.

Research outcomes resulting of public funding are predominantly in the form of publications and patents. The need to provide access to publications freely can only happen if a publication is “grey”. Academic journals or books are under copyrights and can be purchased. Currently only the universities of Liège (French Community) and Ghent (Flemish Community) have adopted an Open Access scheme.

[43] A virtual research centre that aims to stimulate joint translational research based on biobanks (*i.e.* biomedical databases, including biological samples

In terms of patents, the research centres and universities tend to licence their research results via the technology transfer offices (such as e.g. K.U. Leuven, Ghent, Namur or Liège), or via the French speaking universities network of economic exploitation cells of universities (LIEU). The Government agreement of December 2011 does not provide for new legislation but expresses support for a European single patent and it seeks to elaborate a new legal framework for private sector donations.

Rules with regard to commercialisation start at the level of individual researchers. For instance, in Flanders researchers are obliged to comply with provisions laid down by the employer with regard to patent rights and copyrights, with due observance of the legal provisions. The right to apply for a patent falls to the organisation, if the research was conducted under that flag. An employee who creates a possibly patentable invention is obliged to report this in writing to the employer and to transfer all rights to the employer in whole or in part if so requested, in order to enable it to make use of them (Flemish Government, 1998). The university may agree to transfer the right to patent to a third party (usually the cooperation partner) beforehand or apply for the patent itself. Only at a later stage a university may transfer or license the IP rights. As a result, academic inventions are often not transferred or licensed. Patent applications, and their financing, are the responsibility of the universities. Several universities have set up a patent fund. When exploiting a research result (licensing, spin-offs), the university has the duty to protect the opportunity to use the results for further scientific research and education. The researcher has the right to be informed on the status of exploitation of the research findings and a reasonable share in the exploitation revenues. Before 2000, there was a clear lack of expertise about IPR at Flemish universities (VRWB, 1999). However, since the mid-2000s, universities have increasingly professionalised their commercialisation activities. Universities have set up Knowledge Transfer Offices (KTO) that provide information and support on all aspects of IPR and are capable of setting up spin-offs. For example, several universities work together with financial institutions that provide venture capital for the start up of companies and spin-offs.

A challenge to PPPs is to link research and innovation. This becomes visible in Flanders (due to more systemic evaluation): The competence pole schemes struggle to leverage income from the private sector and do not succeed to source increasing funding from the industry, while evaluations of the Strategic Research Centre structurally conclude that the valorisation of their knowledge is their toughest challenge. The business sector is not strongly involved in the governance of universities in Belgium. The independence of academic research is highly valued and universities have a very large degree of autonomy.

6. Enhance knowledge circulation across Europe and beyond

Given that they are open to foreign researchers, the Belgian RIs are important contributions to European knowledge building and knowledge circulation. They all offer high European added value.

In terms of the open circulation of knowledge, the DRIVER projects[44] have been instrumental in developing Open Access awareness across the Belgian scientific community. Ghent University Library was the Belgian partner in those projects and created a Belgian repository community, DRIVER Belgium. Several technical and legal meetings were organised, the DRIVER Guidelines were distributed to repository managers and a national search interface for the driver compliant OA-repositories was set up. The national conference in February 2007 brought together major stakeholders in Belgium. Fourteen university rectors, the ministers of science of the Flemish and French communities and the president of the Flemish Council of Schools for HE signed the Berlin Declaration on Open Access to Knowledge in the Sciences and Humanities

The regions facilitate two measures that enhance knowledge circulation. First, the National Contact Point enhances participation and brokerage, mainly aimed at participation to the Framework programme, CIP and other EU-initiatives. Moreover, the Enterprise Europe Network sets out activities for platforms, networking, and brokerage between regional and foreign companies. This includes initiatives for exchange of knowledge or other such measures.

[44] http://www.driver-repository.eu/

The University of Liège adopted an institutional ID/OA mandate (immediate deposit – optional access[45]) in May 2007. In the same year the university organised an Open Access meeting resulting in the creation of Enabling Open Scholarship (EOS), whose goal is to unite universities and research institutions worldwide, particularly with regard to the creation, dissemination and preservation of research findings. In December 2009, also Ghent University adopted an institutional ID/OA mandate.[46]

The Federal BELSPO offers access to scientific and technological information via its STIS service[47]. The service is offered to individuals as well as companies on a cost basis. It provides access to journals, patent databases and tailored searches.

7. Strengthen international cooperation in science and technology and the role and attractiveness of European research in the world

According to a soon to be published study from DG Research & Innovation (DGR&I, Forthcoming), Belgium is ranking just under the countries that cooperate internationally in S&T in the EU. The Federal Science Policy Office is responsible for coordinating the preparation and the follow-up of the scientific part of the bilateral agreements for economic, industrial, scientific and technological cooperation that Belgium concluded with a number of third countries (China, Russia, and Vietnam). Since 1997, Belgium has also concluded an agreement with Argentina in the space activities area. S&T cooperation can take various forms: information exchange, exploratory expert missions, common research and demonstration or projects for economic exploitation of results. The federal level (Belgian development cooperation and BELSPO) also supports the Belgian Congolese research consortium forming the Congo Biodiversity Initiative. This initiative is largely thought of as capacity building and research. It brings together three national Belgian research institutes and the University of Kisangani of the D.R. Congo.

The Walloon region's external relations are articulated together with the Brussels-Capital region and the Wallonia-Brussels Federation International (WBI), a public administration in charge of supporting the regions' development with international partners. Mainly oriented towards exporting the goods produced in the Walloon and Brussels regions, it also has activities in the research and higher education sector. It has signed a series of bilateral agreements for scientific cooperation. Agreements with geographically close and French-speaking countries are preferred; Canada is an important partner as well as China, Japan, Chile, Russia or Brazil, which are equally Walloon scientific partners.

In the Wallonia-Brussels Federation, the F.R.S-FNRS has established a number of bilateral agreements with Taiwan, Mexico, Japan, United States, Korea, China, Brazil, and Argentina.

The Region of Brussels-Capital has signed several bilateral collaborative agreements with a large number of cities within and outside Europe. Several of these agreements contain a research component to facilitate international cooperation between Brussels and foreign actors. The Brussels universities (ULB, VUB) benefit from these agreements and have a long experience in bilateral relationships with European and international universities or research centres. The cooperation agreements allow them to perform students' exchanges, to organise post-doctoral schools and programmes, to exchange staff and to build EU and international projects. In 2011, a new collaboration was launched between Brussels and the city of Xi'An and its university in China. This new, innovative and multisectoral collaboration is led by the VUB and will lead to joint research, joint labs between the two universities, common economic exploitation of research but also joint masters and PhDs.

In Flanders, international cooperation is being executed via various channels. First, Flanders organises international programmes, structural or ad hoc policy initiatives with (priority) partners, especially bilaterally with the Netherlands; and with other specific EU countries or regions via direct links or indirectly, for instance through EU Interreg IV initiatives. Second, bilateral research cooperation exists with Vietnam, Québec, Ecuador, China and South-Africa. Third, cooperation projects were set up for researchers with China, France, Taiwan, South Korea, Japan, Bulgaria, Poland, Brazil, and Argentina.

[45] http://openaccess.eprints.org/index.php?/archives/71-The-Immediate-DepositOptional-Access-IDOA-Mandate-Rationale-and-Model.html

[46] http://www.openaire.eu/en/open-access/country-information/belgium

[47] http://www.stis.belspo.be/en/stis.asp

Fourth, there is Flemish public support to initiatives of / access for Flemish STI-actors: for example Big Science projects: CERN-CMS & CERN-ISOLDE (Genève); ESRF-DUBBLE (Grenoble); EMBO (Heidelberg); ESO, (Munich-Santiago); Mercator telescope (La Palma), Fifth, there are technological Attachés in important cities (Tokyo, New York, Beijing, Los Angeles, New Delhi) that focus on 5 STI-fields such as energy or nano-materials.

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List of Abbreviations

AEQES	Agency for the Evaluation of the Quality of Higher Education provided by the Wallonia-Brussels Federation
AgODi	Agency for Education and Training
AO	Enterprise Agency Flanders
ASE	Walloon Economic Stimulation Agency
AST	Walloon Technological Stimulation Agency
BELSPO	Belgian Federal Science Policy Office
BERD	Business Expenditures on Research and Development
BOF	Special Research Fund (Flanders)
CERN	European Organisation for Nuclear Research
CFS	Federal co-operation
CIMPS/IMCWB	Inter-Ministerial Conference for Science Policy

CIS	Community Innovation Survey
CLARIN	Common Language Resources and Technology Infrastructure
CMI	Centre for Medical Innovation
COST	European Cooperation in Science and Technology
CTLO	Centre Traditio Litterarum Occidentalium
CWPS	Walloon Council of Science Policy
DG R&D	DG Research and Innovation
DGENORS	Directorate-General for non-obligatory education and scientific research of the Wallonia-Brussels Federation
DGO6	Walloon Operational Directorate General for Economy, Employment and Research
ECOOM	Flemish Expertise Centre for R&D Monitoring
EIROforum	European Intergovernmental Research Organisations Forum
EPO	European Patent Office
ERA	European Research Area
ERA-NET	European Research Area Network
ERDF	European Regional Development Fund
ERP Fund	European Recovery Programme Fund
ESA	European Space Agency
ESF	European Social Fund
ESFRI	European Strategy Forum on Research Infrastructures
ESO	European Organisation for Astronomical Research in the Southern Hemisphere
ESRF	European Synchrotron Radiation Facility
ESS	European Social Survey
EU	European Union
EU-27	European Union consisting of 27 Member States
EUMETSAT	European Organisation for the Exploitation of Meteorological Satellites
EUROHORC's	European Heads Of Research Councils
EWI Department	Department for Economy, Science and Innovation of the Flemish Government
F.R.S-FNRS	National Scientific Research Funds of the French Community
FDC	Flanders District of Creativity
FDI	Foreign Direct Investments
FFEU	Finance Fund for Paying of Debts and Investments
FiA	Flanders in Action
FIRST	Training and Impulsion to Scientific and Technological Research
FIT	Flanders Investment and Trade
FP7	Seventh Research Framework Programme 2007-2013
FRIA	Fund for Research and education within Industry and Agriculture
FRWB-CFPS	Federal Science Policy Council
FTE	Full Time Equivalent
FWO	Research Foundation Flanders
GBAORD	Government Budget Appropriations or Outlays on R&D
GDP	Gross Domestic Product
GERD	Gross Domestic Expenditures on Research and Development
GOVERD	Government expenditures on Research and Development
GUF	General University Funds
HADES	High Acceptance Di-Electron Spectrometer
HEI	Higher Education Institution
HERD	Higher Education Expenditure on R&D
HRST	Human Resources in Science and Technology
IBBT	Interdisciplinary Institute for Broadband Technology
ICC-INFRA	International Cooperation Commission/ Infrastructure
ICOS	Integrated Carbon Observation System
ICT	Inofomration and communication technology
ILL	Institut Laue-Langevin
IMEC	Interuniversity Micro Electronics Centre
INNOVIRIS	Institute for the support of Scientific Research and Innovation of Brussels
INPAC	Institute for Nanoscale Physics and Chemistry, University of Leuven
IOF	Industrial Research Fund
IPR	Intellectual Property Rights

IUS	Innovaton Union Scoreboard
IWT	Agency for Innovation by Science and Technology
JRC	Joint Research Centre
JTI	Joint Technology Initiative
KTO	Knowledge Transfer Office
KULeuven	Catholic University of Leuven
LIEU	Liaison Entreprises-Universités
OECD	Organisation for Economic Cooperation and Development
OMC	Open Method of Coordination
PASS	Scientific Adventure Park
PMV	Participatie Maatschappij Vlaanderen
PPP	Public-Private Partnerships
PRACE	Partnership for Advanced Computing in Europe
PRINS	Pan-European Research Infrastructure for NanoStructures
PRO	Public Research Organisation
R&D	Research and development
RBINS	Royal Belgian Institute of Natural Sciences
RI	Research Infrastructures
RTDI	Research, Technology, Development and Innovation
S&T	Science and technology
SCI	Science Citation Index
SF	Structural Funds
SHARE	Survey of Health, Ageing and Retirement in Europe
SIM	Strategic Initiative Materials
SME	Small and Medium Sized Enterprise
SOWALFIN	Walloon SME Financing Agency
TBM	Programme for Applied Biomedical Research (Flanders)
TEA	Total Entrepreneurial Activity
T-EMAT	Electron Microscopy for Materials Science, University of Antwerp
TTO	Technology Transfer Office
UCL	Liege Catholic University
USPTO	United States Patent nad Trademark Office
VC	Venture Capital
VIB	Flemish Interuniversity Institute for Biotechnology
VINNOF	Flemish Innovation Fund
VITO	Flemish Institute for Technological Research
VLIR	Flemish University Council
VLIZ	Flanders Marine Institute
VRWI	Flemish Science and Innovation Council
VUB	Free University Brussels
WBI	Wallonia-Brussels International
WELBIO	Walloon Institute for Life Sciences

European Commission

EUR 25700 – Joint Research Centre – Institute for Prospective Technological Studies

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Abstract

The main objective of the ERAWATCH Annual Country Reports is to characterise and assess the performance of national research systems and related policies in a structured manner that is comparable across countries. EW Country Reports 2011 identify the structural challenges faced by national innovation systems. They further analyse and assess the ability of the policy mix in place to consistently and efficiently tackle these challenges. The annex of the reports gives an overview of the latest national policy efforts towards the enhancement of European Research Area and further assess their efficiency to achieve the targets.

These reports were originally produced in November - December 2011, focusing on policy developments over the previous twelve months. The reports were produced by the ERAWATCH Network under contract to JRC-IPTS. The analytical framework and the structure of the reports have been developed by the Institute for Prospective Technological Studies of the Joint Research Centre (JRC-IPTS) and Directorate General for Research and Innovation with contributions from ERAWATCH Network Asbl.

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Working in close cooperation with policy Directorates-General, the JRC addresses key societal challenges while stimulating innovation through developing new standards, methods and tools, and sharing and transferring its know-how to the Member States and international community.

Key policy areas include: environment and climate change; energy and transport; agriculture and food security; health and consumer protection; information society and digital agenda; safety and security including nuclear; all supported through a cross-cutting and multi-disciplinary approach.

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